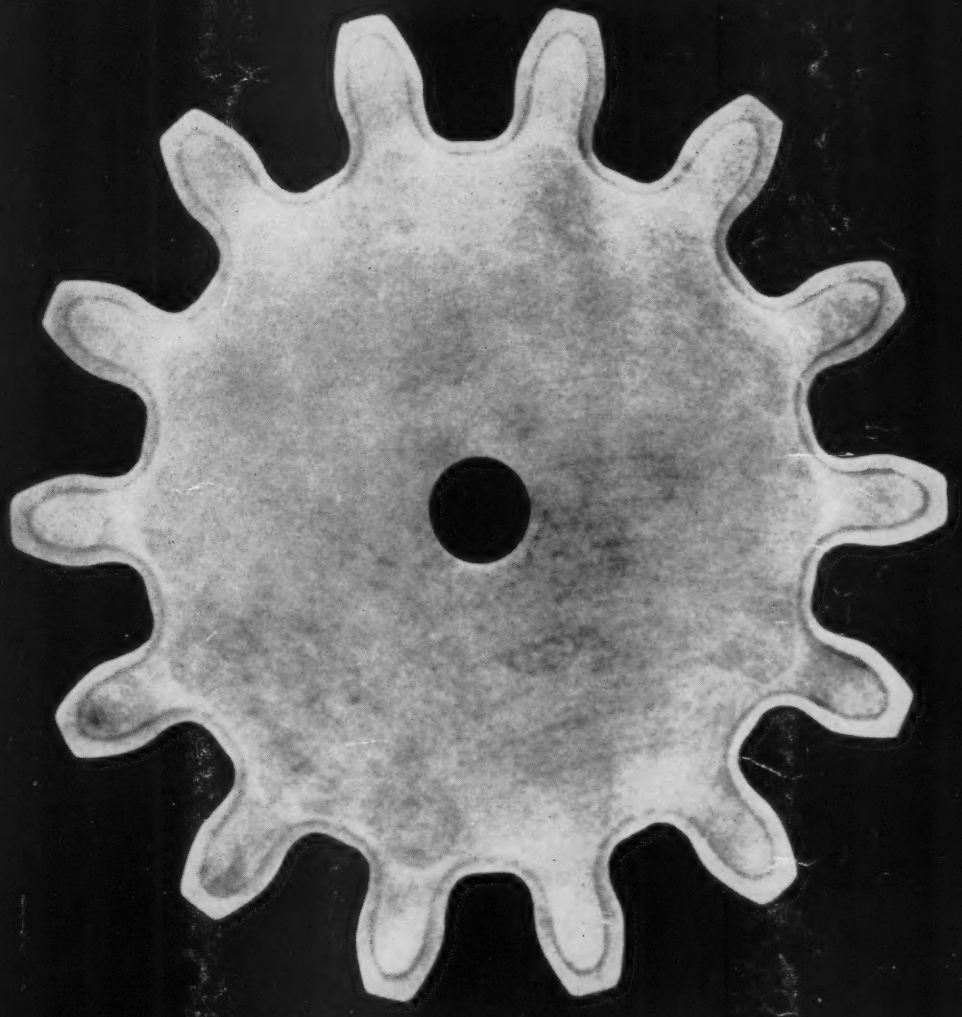
JAN 4 1958

Design Engineering

FIVE DOLLARS A YEAR



June 1958

Induction heating 51
Developing a plastic wheel . . 58
Spring design 67

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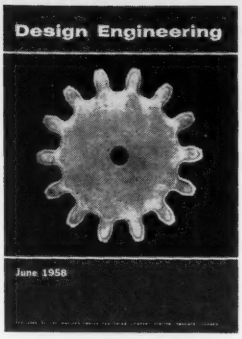

Design Engineering

VOL. 4 JUNE 1958 No. 6

This month's cover

In simplicity there are often to be found the best visual effects. Our June cover would seem to bear this out. A gear on a black background —nothing more to it than the addition of two bands of colour. Combined with an offbeat shade of purple we feel the result is good. "Sam" Smart was the artist. The inspiration came from the induction heating article which kicks off the main editorial section.

Design Engineering

MEMBER

CCAB

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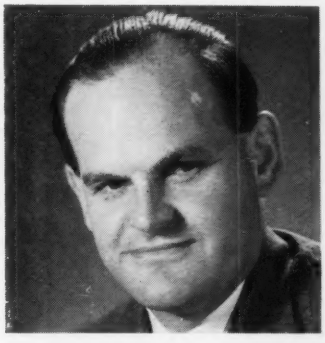
Authors

John C. Lewis (Magnetic field hardens surface skin) is a sales representative in Hamilton for the Tocco division of the Ohio Crankshaft Co. Lancashire-born Lewis came out to Canada three years ago after a 5½-year stint with the RAF as a radio mechanic (some spent in Labrador) and considerable experience in the induction heating field with A. C. Wickman Ltd. Married and with three children, one born over here, Lewis is an embryo hi-fi fiend.



LEWIS

RISTIC

V. S. Ristic (he wrote the article on the plastic wheel) was born in Yugoslavia in 1922 and went to public school, high school and the beginning of university there during the war and occupation years. During student days he was an active man in rowing and represented his country in the Olympic Games in 1948 at Henley. He came to Canada in 1951 and entered U. of T. the same year. After graduating in mechanical engineering in 1954 he became project engineer and then took charge of one-man telephone cable section in the engineering department of the Phillips Electrical Company in Brockville. He is now a field engineer with the Ontario Research Foundation and it was with them that he made his research into the design of a large military wheel made of glass-reinforced polyester resin. He lists skiing, swimming, canoeing and tennis as sports.

A. M. Setapen (These filler materials stand the heat) is manager, engineering division, Handy and Harman—a company that he has been associated with for seventeen years. He has spent three years in research on the industrial use of silver and its alloys (at the Bureau of Standards in Washington. Author Setapen wrote an article on silver brazing for the January issue last year and we managed to put his picture with another author's write-up. Here he is.

SETAPEN

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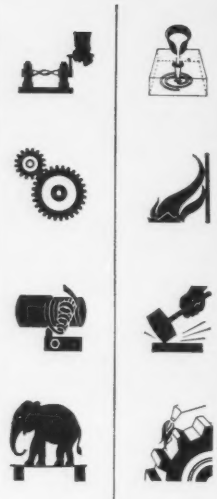

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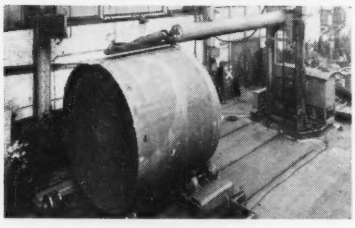
Reports

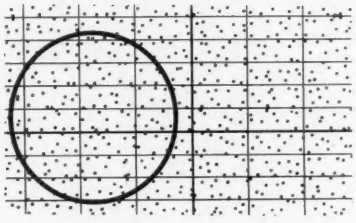
A news roundup of items of engineering and design interest from the world over

I'm certainly not asleep! I'm welding



The U. K. has come up with this answer to the problem of increasing production of large welded cylindrical vessels. A high-lift boom of 17½ ft length is mounted so that the height of the boom above the roller bed is variable to accommodate vessels of different diameters. The automatic welding head is, of course, at the free end of the boom. Provision is made for the operator and his equipment to be carried at the end of the boom. All motions of the roller bed, as well as all welding conditions, can be controlled by the operator at the welding head.

Simple sheet finds irregular areas fast



A canny device to come across our desk recently was something known as an Areagraph chart. It is used for finding areas of both regular and irregular shapes.

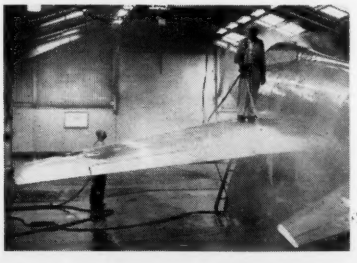
In order to use the chart, simply lay it over the area to be measured and count the dots falling within the area. Divide the number of dots by 30 and the answer will be in square inches. The chart has 10 dots per square inch for easy counting. Claiming a degree of precision of at least 90%, this is an extremely clever arrangement and, above all, it works.

Old religious writings electronically translated

There was a considerable splash in theological circles some while back at the discovery of the controversial Dead Sea Scrolls. This exciting biblical find has had its interpretation brought many years closer with the recent printing of the first complete index of a major portion of the 2,000 year old documents.

An IBM 705 electronic computer transposes prose into a series of mathematical relationships and is capable of making a qualified guess as to what words were originally written in the hundreds of mutilated sections. The computer analyzes the word preceding and following each gap, taking into account size of the gap and the possible number of characters it might have contained. Thousands of words used in the Scrolls are then electronically scanned until the computer finds one that in all respects fits into the context.

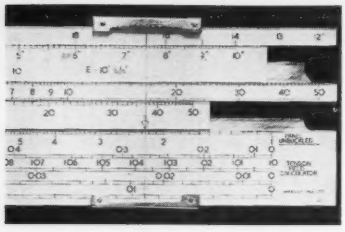
Metal preservative that's cheap to remove



Researchers in California have developed a low-cost liquid preservative to prevent corrosion of airplane assemblies and parts undergoing inspection. Sprayed on, the preservative can be sprayed off with an inexpensive solvent. It can also be removed by steam cleaning, although it resists rain and weather. Its removal is faster and cheaper than that of any other effective preservative, making it ideal for in-process protection of parts.

The coating need not be removed prior to machining, tooling use or part operation. The preservative, which protects both ferrous and non-ferrous metals is a non-oxidizing wax-type material with excellent ability to penetrate nooks and crannies.

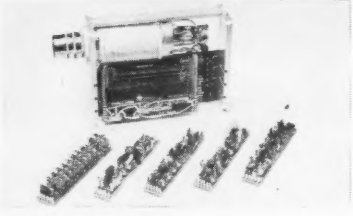
Slide rule eases the stressman's burden



The design and stressing of shear-carrying panels is a routine, time-consuming calculation performed by nearly all structural design engineers, especially in the aircraft industry, where it is vital to use as light a structure as possible. An Englishman (K. G. F. Noble) has designed a calculator in slide rule form for assisting in the design and stressing of flat rectangular panels in shear.

This calculator gives, within a few seconds, buckling shear stress, shear stress ratio, flange loading factor, rivet loading factor, flange bending moment factor and flange end load factor.

TV camera you could almost pocket



Recently, everyone is scrambling for a title as the maker of the world's smallest something or other. Holder of the title in the television camera field seems to be the one shown at left.

This transistorized camera has hunched itself into a unit measuring only 2⅜ in. by 5⅜ in. by 7¾ in. (slightly more than a paper-backed book). With all the technical features of broadcast equipment, it weighs only 4 lb.

Price tag for this camera, if you're interested, is quoted as being "around $8,000."

The 180-ft. bridge that went up in 4 hrs.

It took engineers just four hours to erect a single-span 8,500 lb aluminum bridge spanning the Grand River at Breslau, Ont. Shop fabricated and moved nine miles to its site in three 60 ft sections, the completed bridge is 180 ft long, 16 ft high and 9 ft wide. A steel bridge of similar design would probably weigh around 30,000 lb and require stronger and more costly concrete abutments. Another cost saving is the maintenance, inasmuch as the aluminum bridge will never need to be painted.

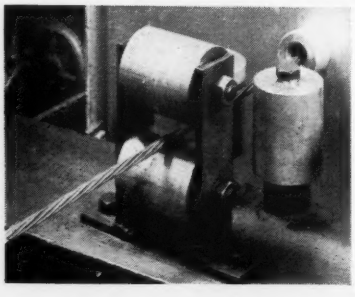
The structure is composed of about 270 triangles of tubular aluminum, all shop fabricated. The tubes were joined by using formed aluminum sheet or tents.

Giant casting registers a Canadian record

A record for the Canadian metals industry was established early in April with the pouring of a 330,000 lb steel casting, largest ever produced in the country. The giant casting is the bottom platen for a 6,000-ton wheel forging press. The mold for the casting was a month in the making, and took almost two weeks to cool.

Our picture was taken at the height of the pouring and shows the three large ladles which provided the continuous supply of molten metal.

Now this type of wire is made in Canada



Manufacture of stress-relieved wire began in Canada early this year in Vancouver.

One of the key elements in pre-stressed concrete, stress-relieved strand provide longitudinal strength in concrete members through metallurgical properties that permit controlled elongation of the strand. Using equipment designed and built in Vancouver, the strand is passed through a furnace at specified speeds and temperature which alters the micro-structure of the steel, resulting in controlled elongation characteristics. By means of extremely careful elongation testing, stress-strain graphs are prepared from which engineers work in applying the strands to the job.

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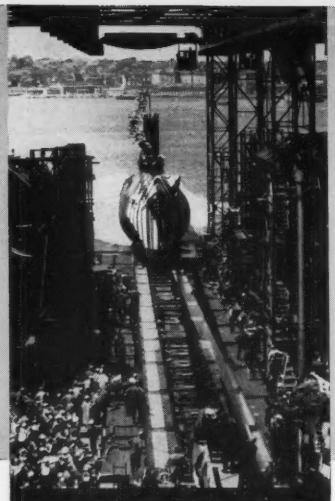


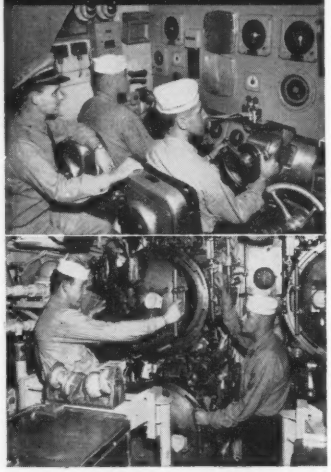
U.S.S. SKATE

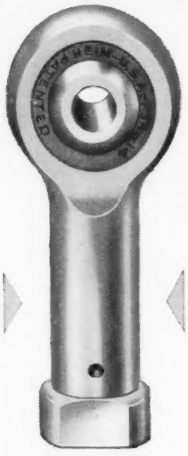
Launched in May, the atomic submarine, Skate, started its builder's trials in November, and in March, made a record crossing to Europe. Built by General Dynamics Corporation's Electric Boat Division of Groton, Conn., it is our third underwater craft to be powered through the use of nuclear fission.

FROM THE CONTROL ROOM, AIRPLANE TYPE "JOYSTICK CONTROLS" GUIDE THE ATOMIC SUBMARINE

Heim Unibal Rod Ends are used here and in the linkages and mechanisms which operate:—

- **The steering and diving gear follow-up xmitter.**
- **Emergency diving control valve.**
- **Stern diving gear.**
- **Steering emergency control valve.**
- **Stern diving gear, follow-up and transmitter drive.**





HEIM
ROD END

The "Guns" of an atomic submarine are its torpedo tubes. Heim Unibal Rod Ends are used here in the torpedo handling gear.

Keeping pace with technological advances, Heim Unibal bearings meet those exacting specifications so vital to the operation of Uncle Sam's fleet of atomic underwater craft. It is reasonable to assume that you do not have the plans for a nuclear-powered submarine on your drawing board at the moment, but, . . . If your product employs a push-pull motion, if power is transmitted at changing angles through linkages of one kind or another, or if the correction of misalignment is a requirement, we know that . . .

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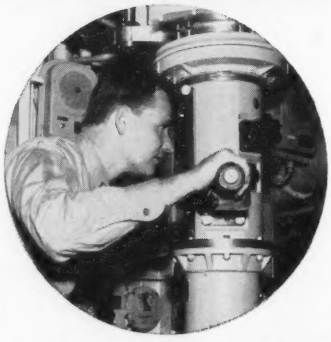

Surface coordinates are checked through the submarine's periscope. All equipment aboard is powered by energy generated from Skate's water-cooled reactor system.

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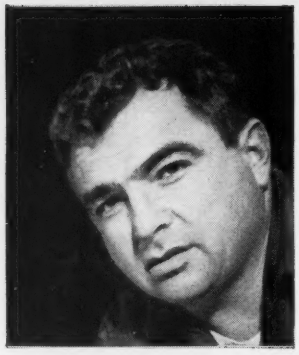

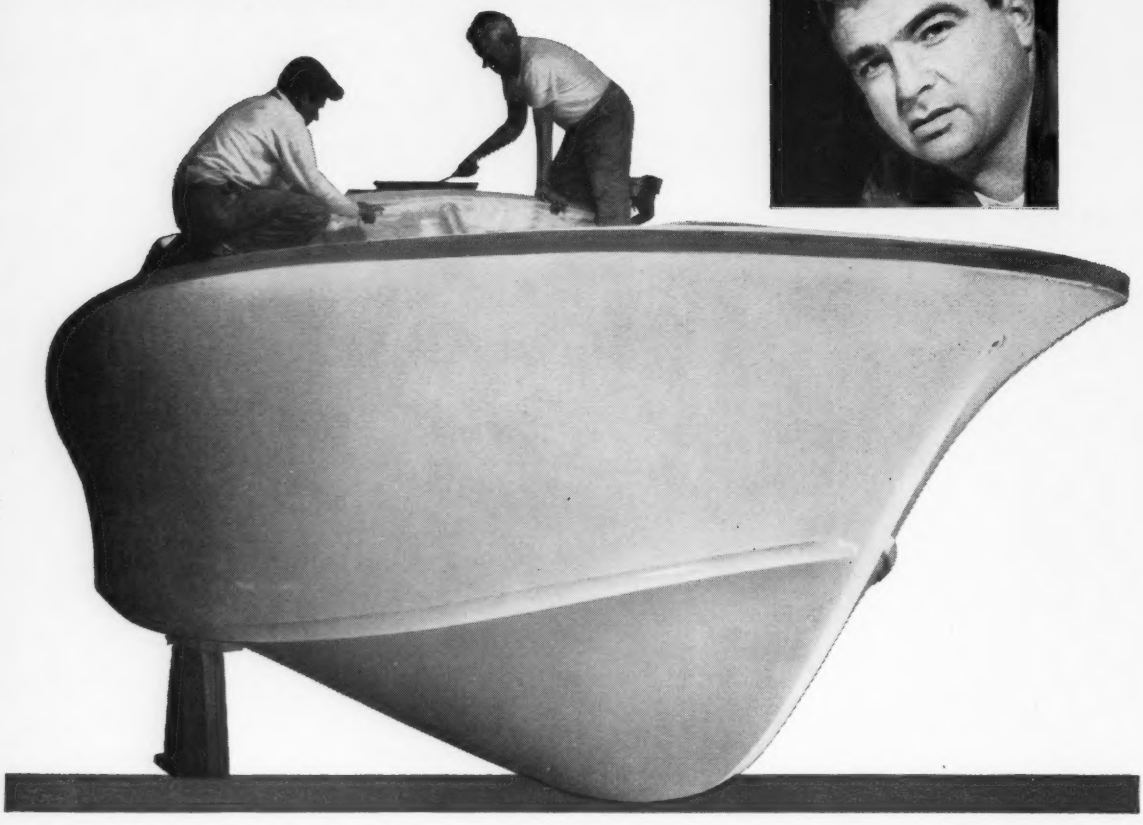

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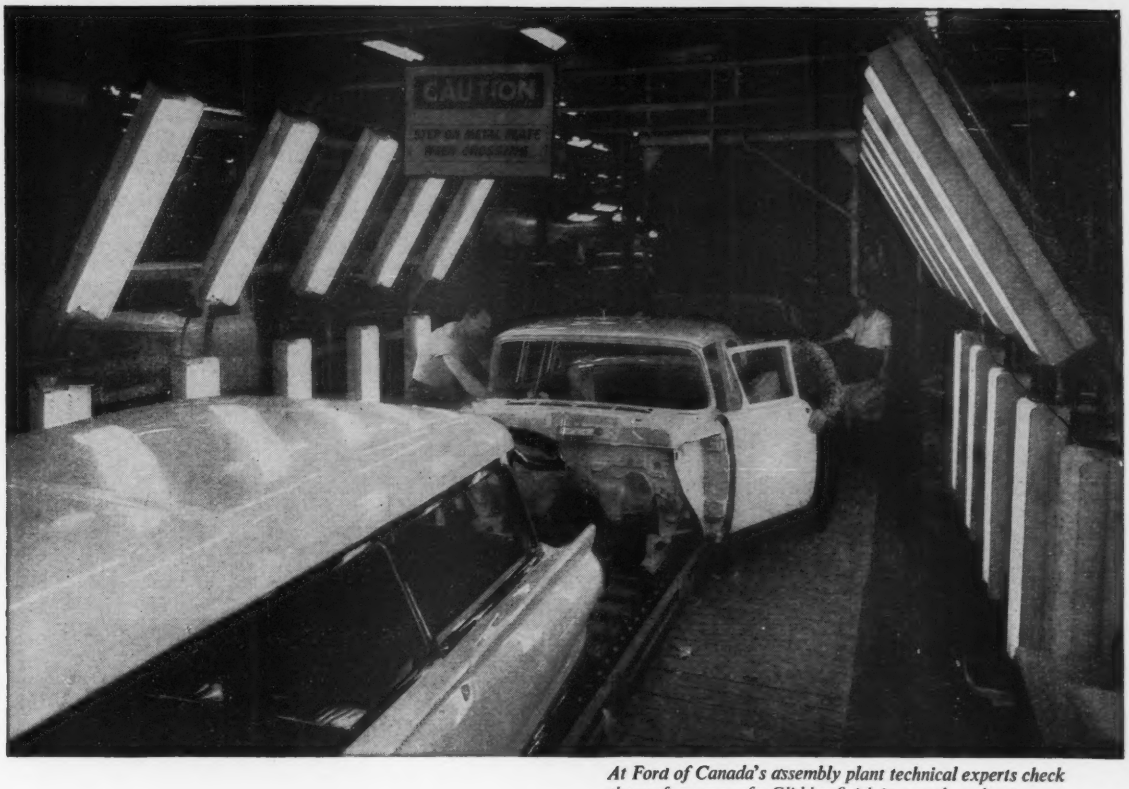

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This booklet outlines all Glidden Technical and Laboratory Services—and how you can profit by them. We will gladly send you a free copy—just write to:

For Glidden, the production of industrial product finishes does not end with delivery to our many customers. You know, as we know, that a crucial test is still to come—performance under actual production-line conditions!

To find out how our finishes behave at this crucial stage we follow up the considerable research testing that takes place at the Glidden Laboratories with on-the-spot checks. In many cases—as at Ford of Canada's assembly plant—Glidden technicians work closely with a company's own experts to check the performance of a finish when applied.

Only when our specialists have seen for themselves that our finishes live up to research expectations do we consider our job complete. Later, frequent checks guarantee continued perfection in quality and performance. In this way we satisfy ourselves that we are meeting your needs completely.

When you specify a Glidden Product finish you get, not only a finish of outstanding quality but also expert assistance at every stage of its use. It is our policy to give every customer the full benefit of our long experience, expert knowledge and unique facilities. Why not take advantage of this to meet your requirements more efficiently and effectively? Contact our service representative or write to us direct at the address below.

I-58-6

QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY LIMITED

Technical Service Department • 351 Wallace Ave., Toronto, Ont. • 133 Elmslie St., Ville La Salle, Montreal, P.Q.

Tubexperience in action

Superior weighs a wall to "zero in" on your tubing tolerance

Weight control gives precise check of tubing dimensions to help your product performance

*These delicately balanced scales weigh a length of tubing accurately to within 1/1000 lb. The relationship of weight to length and to OD tells us how closely the tubing wall or ID conforms to specifications. This fast, precise method of checking average wall or ID enables us to provide you with a tubing order whose overall uniformity is unusually high. In certain applications, tubing produced by this weight control method can materially improve performance for you. It results in minimizing variations in your product caused by tubing whose average wall or ID varies too widely from the required design mean.

This is but one of many modern tools and techniques that help improve the already high quality of Superior small tubing.

Our premium quality small tubing is offered in a range of analyses (over 120) unsurpassed in the industry. Included are stainless, carbon and alloy steels, nickel and nickel alloys, beryllium-copper, titanium and zirconium—and 16 different Super Alloys. Our range of sizes and shapes is equally extensive.

Special services include statistical quality control, pilot and test lot sampling and melting, dye penetrant inspection, ultrasonic and hot tensile testing, eddy current and X-ray inspection, specification services—and field specialists who will call on you at your request.

For handy reference in your files, get a copy of Bulletin 40, "Selection and Application Guide for Superior Tubing." Write Superior Tube Company, 2052 Germantown Ave., Norristown, Pa.

ALLOY METAL SALES, LTD., Montreal, Toronto & Winnipeg **LYMAN TUBE & BEARING, LTD., Montreal, Toronto & Winnipeg** **ROBERT W. BARTRAM, LTD., Montreal**

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All analyses .010 in. to ⅜ in. OD—certain analyses in light walls up to 2½ in. OD

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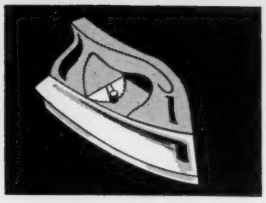
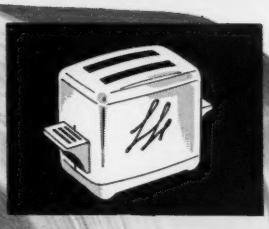
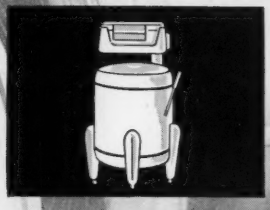
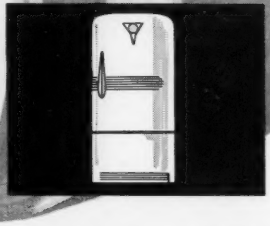
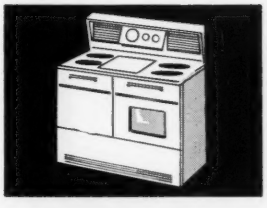
made and processed to proper specifications to meet your exact manufacturing requirements











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CORPORATION, LIMITED

Sault Ste. Marie, Ontario

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Design for

SIMPLIFIED ASSEMBLY

replace multiple parts

with a single polyester molding

In a circuit breaker contact assembly, the large ATLAC THERMAFLOW molding shown here replaces three smaller parts. Molded-in busbars end alignment problems...20 bolts are eliminated from assembly operations. High-strength ATLAC THERMAFLOW 2400 compound permits thinner cross-section, reduces overall size. Molded for General Electric Switchgear Division by Penn Plastics Co., Glenside, Pa.

You can cut assembly costs, reduce need for fastening hardware, and meet close tolerances readily . . . by designing with ATLAC THERMAFLOW reinforced polyester molding compounds. Metal bushings and fittings can be molded in place, to give simple, one-piece construction. You can combine several pieces into a single ATLAC THERMAFLOW molding, because these high strength materials give structural rigidity and ruggedness in large shapes . . . and they're easily molded into complex forms.

In addition, ATLAC THERMAFLOW materials offer:

- **Excellent electrical properties: insulation resistance**
- **and arc tracking resistance**
- **Weight savings: specific gravity 1.8**
- **High impact and flexural strength**
- **Superior corrosion resistance**
  Good surface finish . . . no machining needed
- **Variety of attractive colors; paint, if desired, without bonding coat**

ATLAC THERMAFLOW materials can be compression or transfer molded on standard presses, at temperatures from 275 to 350°F, and pressures from 400 to 900 psi. They can be molded readily in shapes with deep draw and intricate detail. Curing time is relatively short.

Choose from many glass fiber and nylon rag reinforced grades. Write today for literature on materials, molding techniques and applications.

Atlac THERMAFLOW—Trademark, Atlas Powder Company

ATLAC THERMAFLOW

ATLAS

ATLAS POWDER COMPANY, CANADA, LTD.
Brantford, Canada
Offices in **MONTREAL, TORONTO, EDMONTON, VANCOUVER**

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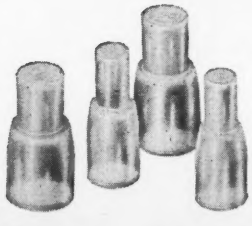
BURCAPs

THE COMPRESSION–INSTALLED SPLICING CONNECTOR

- rated for 600 volts for building wire, 1000 volts for fixtures and signs
- designed to splice a wide range of wire sizes



INSTALLATION TOOLING FOR THE BURNDY BURCAP

Send for tooling information and samples—Write Burndy, 1530 Birchmount Road, Toronto - Scarboro

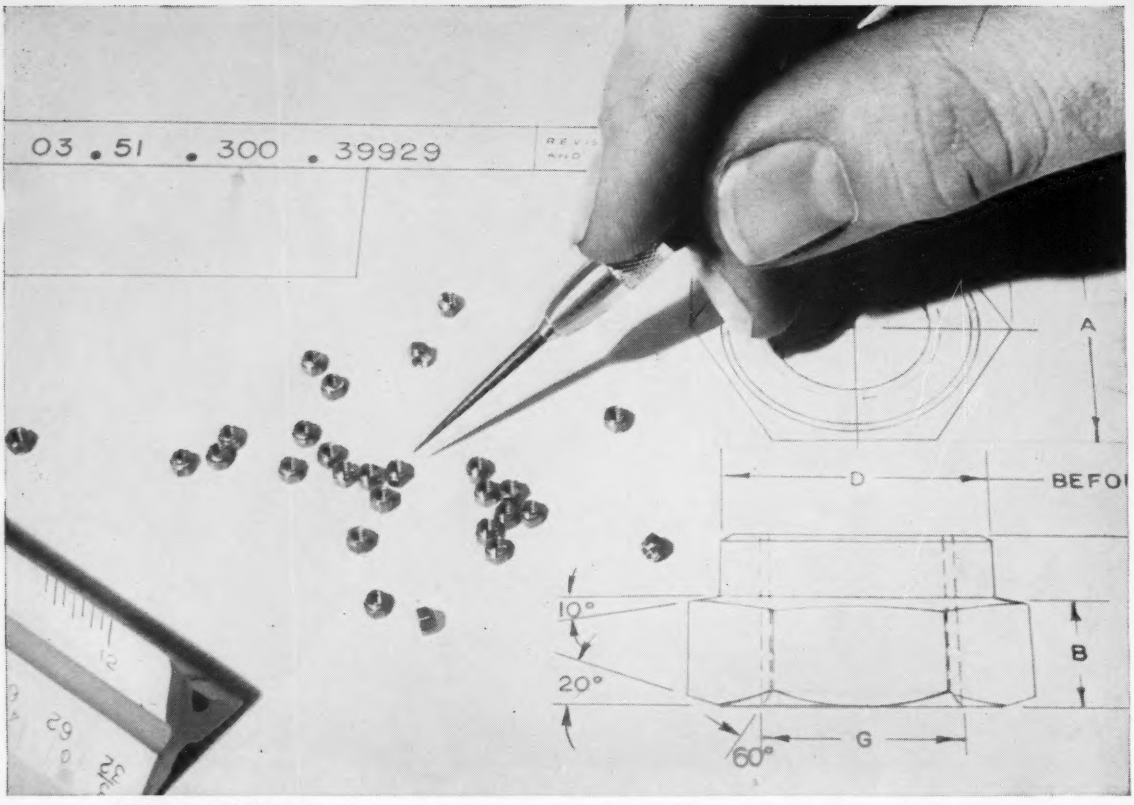
PLYER-TYPE Y150MW

RATCHET-TYPE M8ND

PNEUMATIC-TYPE Y10NCP

OMATON DIVISION

BURNDY



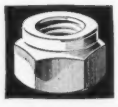
FLEXLOC MICROSIZE locknuts meet designers' needs for tiny precision nuts that retain strength and holding power in the smallest assemblies—servomechanisms, electronic and electrical equipment, all miniature devices.

New FLEXLOC Microsize Locknuts

Now available in Alloy Steel, Stainless Steel, Brass and Aluminum for lighter, more compact designs

SIZE	Across Flats		Hex. Height	Across Corners	Height
	MAX.	MIN.	REF.	MIN.	REF.
0-80 NF-3B	.111	.107	.046	.121	.075
1-64 NC-3B	.127	.123	.056	.140	.090
1-72 NF-3B	.127	.123	.056	.140	.090
2-56 NC-3B	.158	.153	.067	.176	.105
2-64 NF-3B	.158	.153	.067	.176	.105
3-48 NC-3B	.190	.183	.071	.210	.120
3-56 NF-3B	.190	.183	.071	.210	.120
4-40 NC-3B	.190	.183	.071	.210	.120
4-48 NF-3B	.190	.183	.071	.210	.120

SPECIFICATIONS: Available in brass (plain or cadmium plated) and aluminum (plain or chemically treated), for temperatures to 250°F; in alloy steel (plain or cadmium plated) and 18-8 stainless steel (silver plated) for temperatures to 550°F.



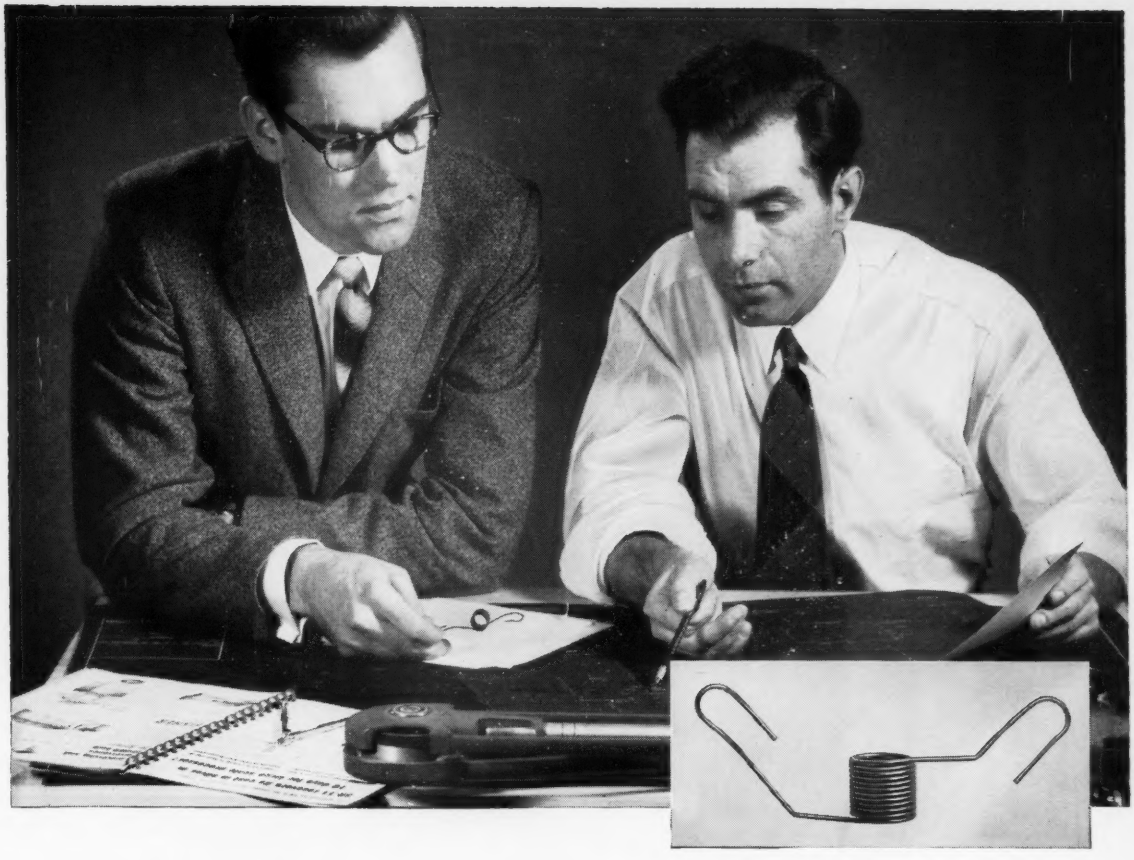
New FLEXLOC Microsize locknuts are smaller and lighter than regular FLEXLOCS of the same nominal diameter. Wrenches of smaller size are used to install them. Mating joints or flanges can be designed smaller—with no loss in strength or convenience of assembly.

Microsize FLEXLOCS have all the advantages of larger FLEXLOCS. One-piece, all-metal construction—nothing to put together, come apart, lose or forget. Use them as lock or stop nuts—they stay put anywhere on a threaded member as soon as the locking threads are fully engaged. Uniform locking torques insure accurate preloading. There are no nonmetallic inserts to pop out or deteriorate. Moisture, dryness, oil won't affect these Microsize FLEXLOCS. Just screw them on. They lock and stay locked. Vibration won't shake them loose.

For complete information on Microsize FLEXLOCS, consult your authorized distributor. Or write:

FLEXLOC®

STANDCO CANADA, LTD.
193 Bartley Drive
Toronto 16, Ontario



need a new twist?

Something new on the drawing board? Then *now* is the time to call in Wallace Barnes' *specialists* in spring design. They are ready to accept your precision mechanical spring problem and help design the exact type, size, tension and temper of spring to do your *specific* job best!

Springs may be a small part of the products you manufacture . . . but they are critical. That's why so many leading companies specify Wallace Barnes Springs!

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We'll design your springs while you design your product . . .

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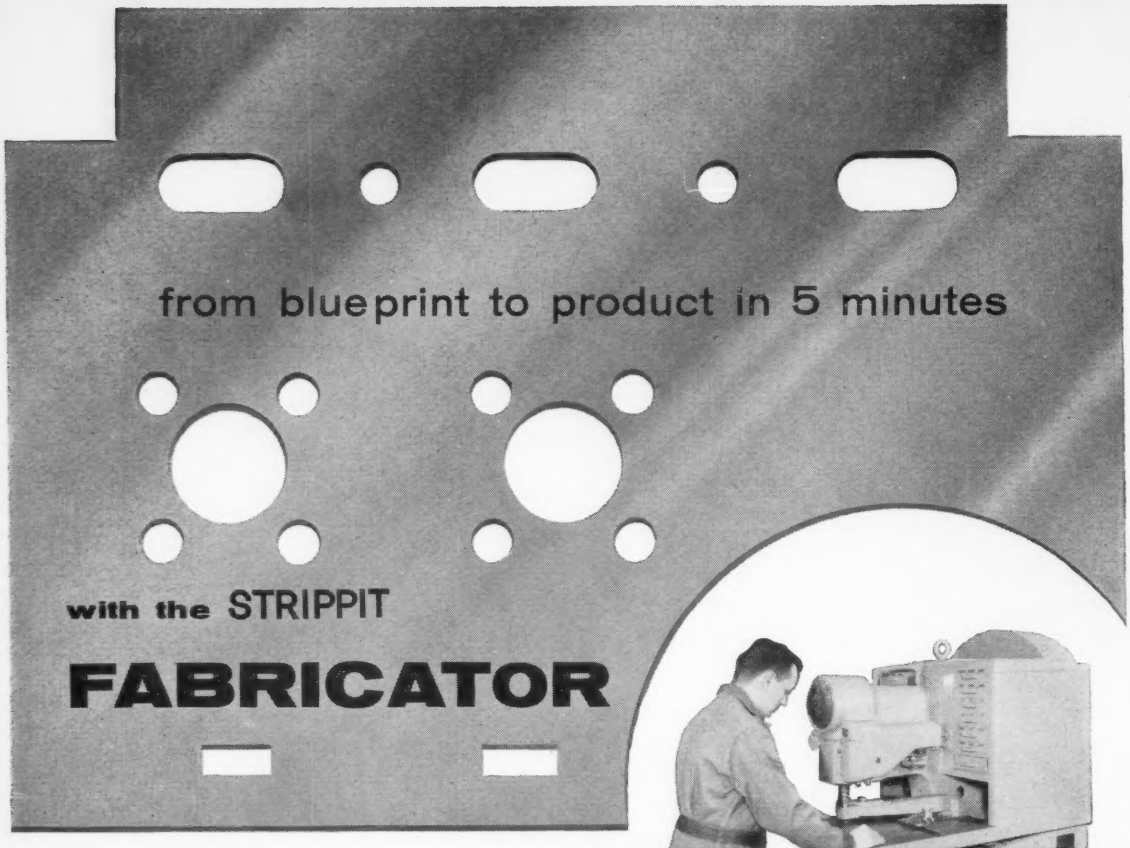

Short run? Complicated pattern? If it's sheet metal up to ¼" mild steel, if it's punching, notching or nibbling, it's profitable on a Strippit Fabricator!

Set up in minutes! Punches and dies are changed in 30 seconds or less, and Strippit guided punches need no aligning or adjusting. Back stop with precision gauge is instantly set by a locking knob. Self-tripping finger stops on gauge bars provide multiple stopping as the work is moved rapidly under the punch. A switch gives you single punching or 165-stroke-a-minute nibbling, and all tools are within quick reach in attached "file drawers" or shelves. The Fabricator is more than a one-machine shop — it's a whole system of quick-change, high-profit fabrication used by thousands of shops.

What's more, you can add the Strippit Positive Duplicator for high-speed punching in medium runs — plus the Dupl-O-Scope to punch Duplicator templates right from the drawing, in a few minutes. Write today for details and demonstration at your plant by the Strippit mobile unit.

Special tools made up to your specifications.

STRIPPIT
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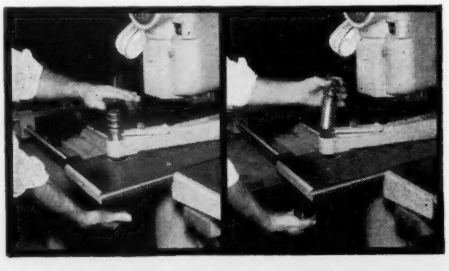
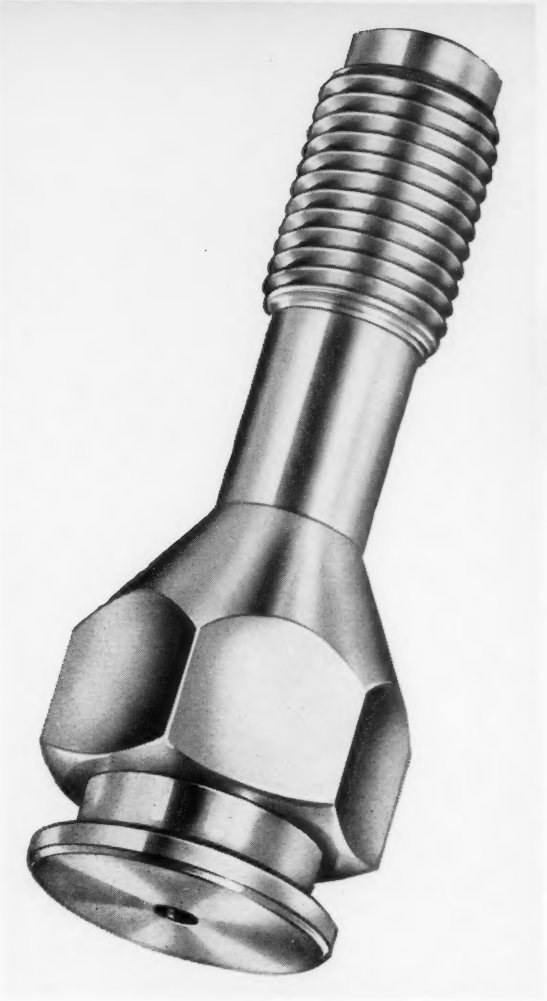
THE STRIPPIT FABRICATOR—a single compact multi-purpose Punch Press with quick-change tool holder, quick-set gauging and stops.

BELOW, TOOL HOLDER is pulled out, for instant removal of die and punch assembly, ready for the next interchangeable tool. 1¼" diameter capacity holder shown. 3½" diameter holder also available.





CUT PRODUCTION COSTS!

Here is an excellent example of how a leading Canadian Manufacturer reduced his overall production costs by having certain components made by the Screw Machine Division of the Weatherhead Company. The manufacturer not only saved money on the components but also valuable man hours and machine time. Production of the project was therefore accelerated—result, greater production, lower overall cost.

Weatherhead produces thousands of precision-made components, such as this, in the million quantities, for Canada's major manufacturing industries. Our manufacturing "know-how" in producing components made from brass, steel, aluminum, nylon and other materials may change the profit picture of your end product.

Our sales representative can tell you how economically we can produce any quantity, small or large. We welcome your enquiry. Send in blueprints, specifications or samples for quotation. Address your enquiries to Dept. SM, The Weatherhead Company of Canada Ltd., St. Thomas, Ontario.

THE MARK OF QUALITY

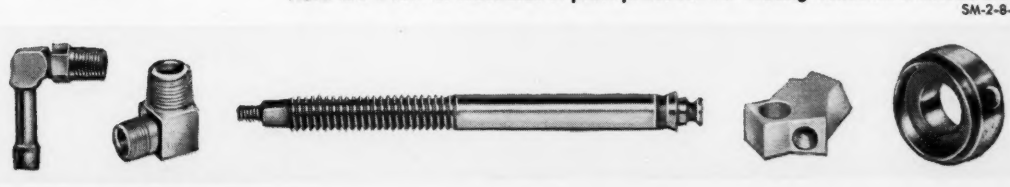
WEATHERHEAD

SCREW MACHINE DIVISION

St. Thomas, Ontario

Here are a few of thousands of parts produced for leading Canadian manufacturers.

SM-2-8-2C

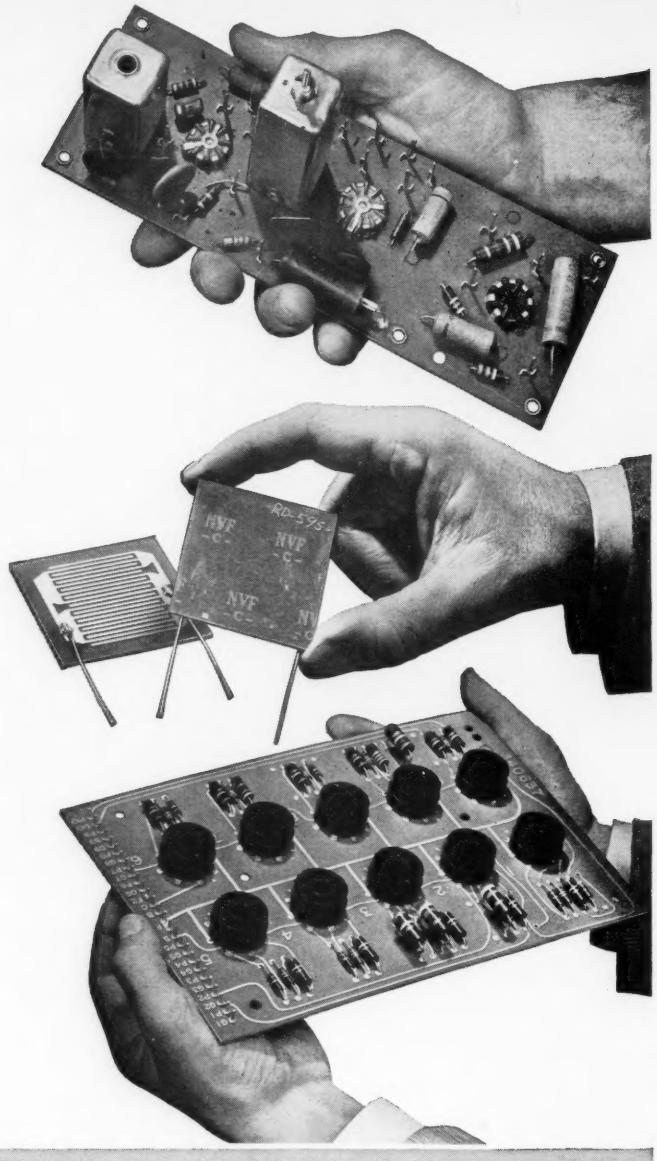


TEN-TO-ONE THE **Copper Clad Laminate** YOU WANT IS HERE!

From these ten basic PHENOLITE® Grades, you can select the base material, resin, properties and price to fit your present printed circuit need.

If your problem is finding a suitable cold-punch material, try samples of XXXP-470-1. It's designed for use in automated production equipment. If you are looking for higher heat resistance, check Grades G-10 and G-11.

Out of National's research laboratories come new advances every day. See your National Representative about new products and applications. He can keep you posted on the full line of PHENOLITE Laminated Plastic, Vulcanized Fibre and National Nylon for electronic applications across-the-board. In the meantime, write for our new "PHENOLITE Copper Clad Data" folder. Address Dept. N-6.



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FIBRE COMPANY OF CANADA, LTD.
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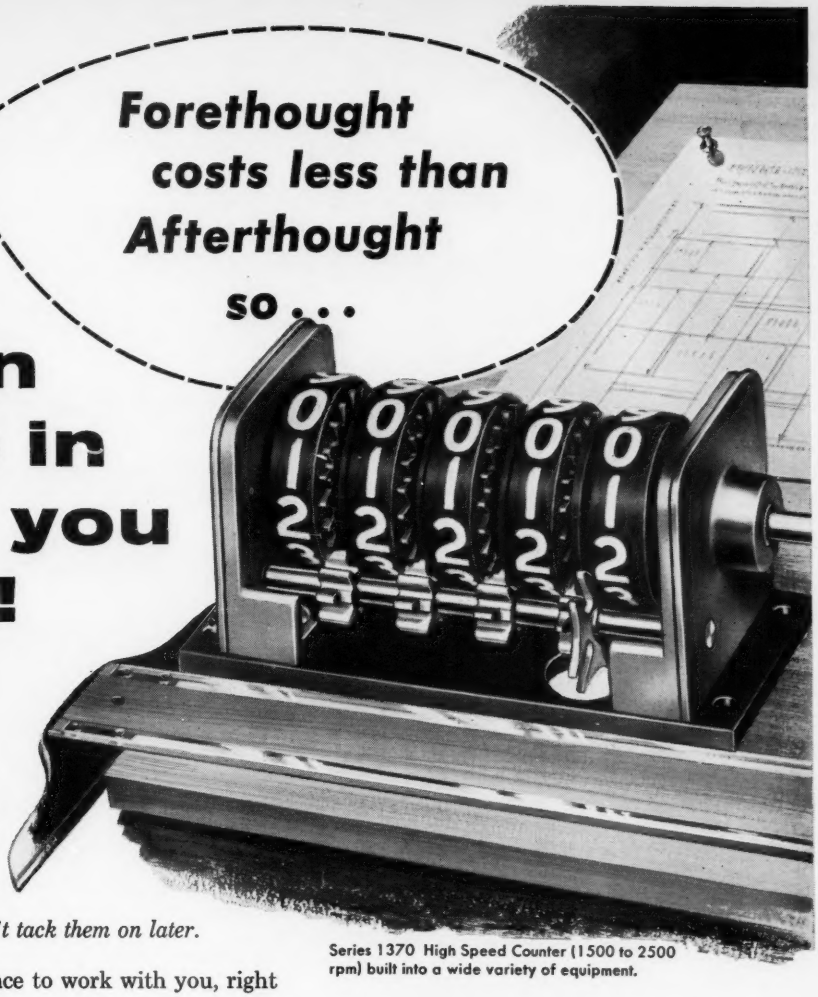
TYPICAL TEST VALUES ON COPPER CLAD PHENOLITE

GRADE	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES				RELATIVE COST
	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance	Surface Resistance	Based on XXXP on Arbitrary Scale of 1
						Pounds to Pull 1" Strip		Secs to Blister 1" Square > Greater Than	Megohms, Etched Retma Comb Pattern, 96 Hrs/35°C/90% RH	
	10^6 Cycles	10^6 Cycles	⅛", % 24 Hrs	Psi	Degree F	1 Oz	2 Oz			⅛" Thk. 1 Oz. Copper 1 Side
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	>10@ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	>10@ 475°F	200,000	.92
XXP-239-1 PHENOCLAD	4.2	.035	0.67	15,500	250	8	11	>10@ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	>10@ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	>10@ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	>10@ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	>10@ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	>30@ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	>30@ 500°F	2,000,000	3.55

Forethought costs less than Afterthought so . . .

Design These in When you Begin!



Series 1370 High Speed Counter (1500 to 2500 rpm) built into a wide variety of equipment.

If you need mechanical or electrical counters in any of your new products, here's a word to the cost-wise designer: *Design them in, when you begin . . . don't tack them on later.*

For if you'll give us a chance to work with you, right from the beginning, chances are we can save you time and money by adapting or modifying a *standard* Veeder-Root Counter to your needs . . where you might get into a costly special job if you went about it alone. What's more, you save time in your engineering, purchasing and assembly departments.

Count on Veeder-Root to help you in every way . . . from design to delivery. Write:

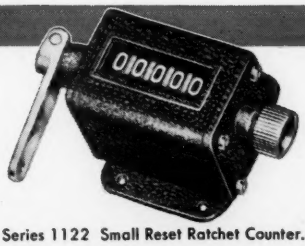
Everyone... Can Count on

VEEDER-ROOT OF CANADA LTD., 955 St. James St., Montreal

VEEDER-ROOT

"THE NAME THAT COUNTS"

Series 1205 Reset Magnetic Counter with panel mount and lock and key.



Series 1122 Small Reset Ratchet Counter.

Special Longitude Counter, one of many made for aircraft navigational equipment.

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COPPER ALLOY BULLETIN

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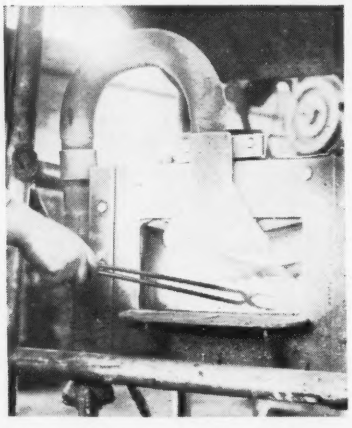
Export Department, 1255 Laird Blvd., Town of Mount Royal, P. Q., Canada

This valve is typical of the wide range of valves and fittings made by Wallaceburg-Singer Limited.

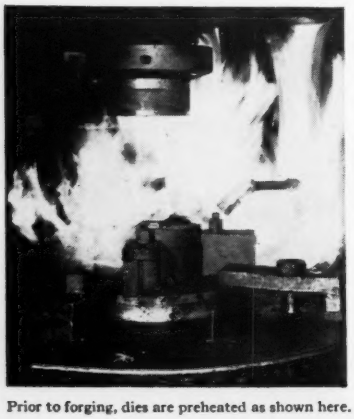
Beginning and end of the process. Billet sawed from Noranda Forging Brass Rod is shown at the left. Cored-forged valve body at the right.



Billets are first heated to a plastic state in furnaces like this.

Popular-Priced Noranda Forging Brass Ideal for New Cored-Forging Method

Wallaceburg-Singer Limited, Wallaceburg, Ontario, is producing high-quality precision brass forgings by a unique cored-forging process, a radical departure from usual casting methods. Cored-forged parts are twice as strong as castings and number among their advantages exceptional lightness, freedom from porosity, and extreme interior and exterior smoothness.



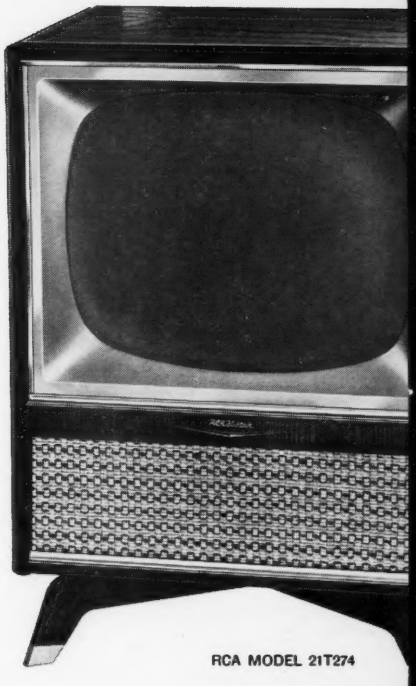
Prior to forging, dies are preheated as shown here.

Briefly, the process involves heating brass billets of predetermined size in a gas furnace to a plastic state (1350°F). At the point of desired plasticity, the billet is molded under pressure in a preheated die. Except for a few simple trimming operations, the part is ready for use.

One of Wallaceburg's cored forgings is a gas shutoff valve made in a wide range of sizes. For this, they use Noranda Forging Brass. Unvarying forging quality and excellent machining properties are essential. Extremely close tolerances are required between the valve and valve body for gastightness. After being forged, the body is turned on an automatic chucking machine which simultaneously machines both ends of the forging and drills at the center. Next both body and plug are machined on a taper-turning lathe, thus insuring an exact fit.

Along with this is Noranda's Technical Service . . . an activity that can be considered as much of a *product* as any alloy or mill form that Noranda makes. Technical Service—like Noranda alloys—is designed to help you to achieve the maximum in economy . . . whatever the application. It is behind every Noranda recommendation. Consider it a part of every Noranda product you buy. For full information, call your nearby Noranda Sales Office today.

another CPI *product through research*



RCA MODEL 21T274

This finish started with research

This beautiful RCA Victor television set has a lustrous, durable lacquer finish to match its flawless design and workmanship —a finish that started with Canadian Pittsburgh research.

Canadian Pittsburgh technicians are ready to diagnose and solve your particular finish problem, carefully applying the same research, skill and service that make these finishes the choice of leading companies like RCA Victor.

GLASS · PAINT · PITTCO METAL

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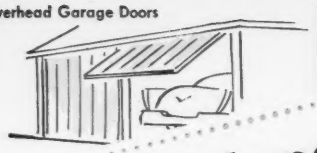
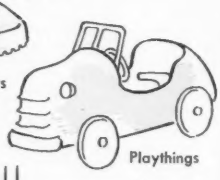
Overhead Garage Doors

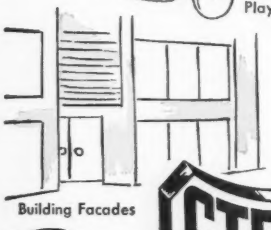


Holds paint like an artist's canvas!

Lawn Mowers



Playthings



Building Facades

STELCO

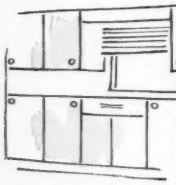
"COLOURBOND"

CONTINUOUS

GALVANIZED STEEL SHEETS

Bus Bodies

Utility Tables



Kitchen Equipment

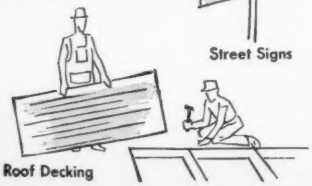
Store Fronts

Trailer Bodies

Picnic Coolers

Fishing Tackle and Tool Boxes

Street Signs



Roof Decking

The coating of pure zinc on Stelco's new "Colourbond" Continuous Galvanized Steel Sheets is applied by an exclusive technique developed by Stelco . . . it produces a soft lustre finish, perfectly suited to the close adhesion of paint and particularly acceptable when a bright surface spangle is not desirable.

No surface preparation is necessary, and no primer coat needed.

As with all other galvanized sheets produced by Stelco's patented continuous galvanizing process, the bond between the zinc and the steel is so tight that the sheets can be worked or formed to the limits of the base steel itself, without any sign of cracking or peeling of the zinc coating.

For every product or building application where a painted surface is required to combine with an anti-rust, anti-corrosion surface use Stelco "Colourbond" Galvanized Steel Sheets — available now, in sheets or coils.

For full information and metallurgical service, contact any Stelco Sales Office.

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Have you explored the full savings potential of Speed Nut spring tension fasteners in your assembly operation? There are more than 8000* types and sizes available...and all are designed and engineered to save you money. Let us do a comprehensive fastening analysis of your product and show you how Speed Nuts can solve your fastening problems by doing the job better, faster and at lower cost.

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Hamilton, Ontario
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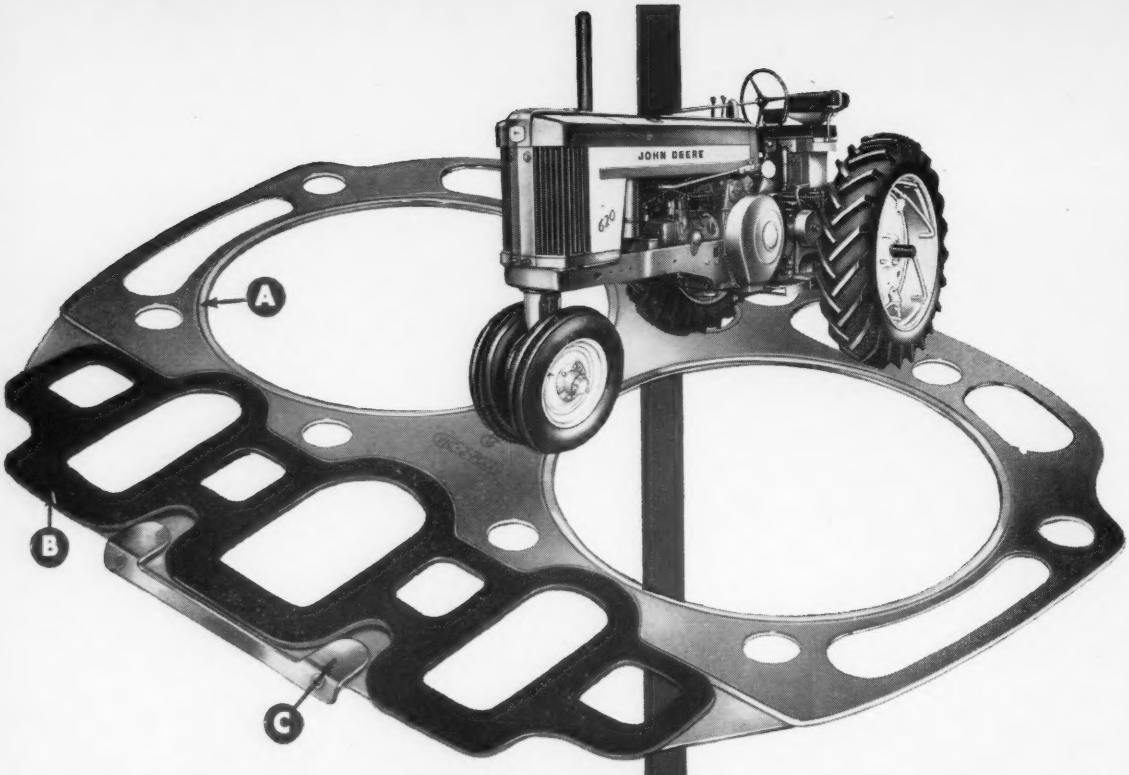
TINNERMAN SPEED NUTS



How JOHN DEERE seals an intricate block casting

JOHN DEERE engineers assume no limitations on what can be done with gaskets. For example, take the case of sealing the Model 620 tractor engine.

Intricate block design created the problem of effectively sealing the coolant ports beyond the area of stud loading. The seal would have to compensate for heat expansion and shifts of the water holes in the block casting. Compressed thickness and resilience of the gasket overall would have to be balanced to insure maximum sealing of combustion chambers, exhaust, fuel and air ports.

Solution Comes from Standard Design

How JOHN DEERE engineers in cooperation with Victor specialists solved this problem is shown here. This partial modification of the standard VIC-2-FOLD design suggests the flexibility and wide scope of economical sealing service available from Victor.

Whatever you have to seal with gaskets or oil seals, Victor's unmatched facilities are yours to use. Contact your Victor Field Engineer or the factory.

Victor Mfg. & Gasket Co., of Canada Ltd., St. Thomas, Ont. In U. S.: Victor Mfg., & Gasket Co., Chicago 90.

A → **VIC-2-FOLD** modern metal-asbestos design insures tight sealing of combustion chambers, exhaust, fuel and air ports. Steel bottom layer, turned up and overlapping copper top layer at combustion openings, gives strong protection against breakdown and blowout. Copper top, turned down and overlapping steel layer, protects against corrosion.

B → **VICTOPRENE** insert, bonded to steel bottom layer, with overlap on openings, provides tight sealing of coolant chambers. Victoprene was selected for its lowest compression set values.

C → **Shim stop of brass,** riveted to bottom steel layer, prevents excessive compression on Victoprene insert.

Your files are not complete without Victor Gasket Engineering Catalog No. 505.

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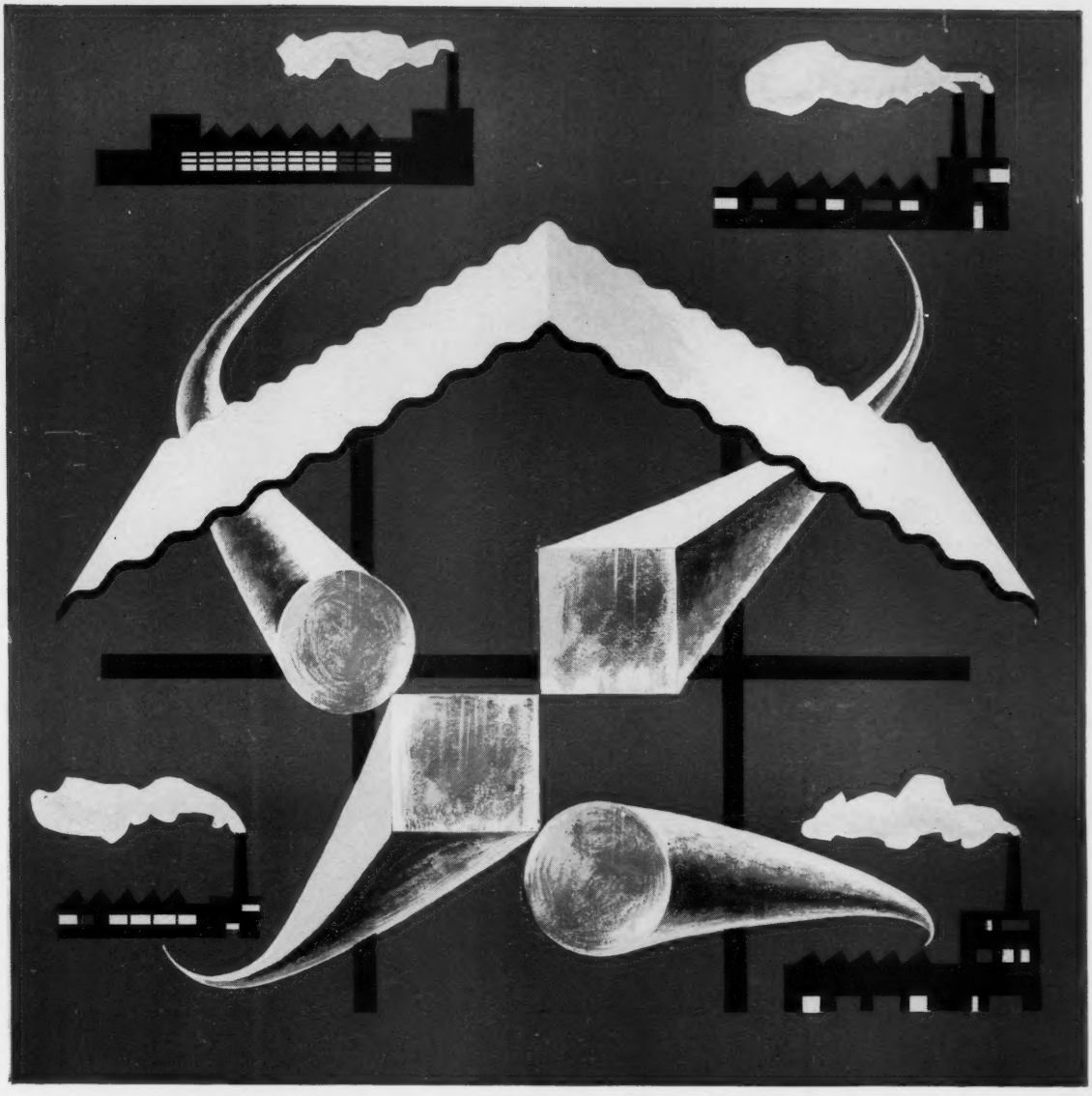

YOUR INVENTORY UNDER *OUR* ROOF

Let Atlas stock your tool steels

Fully stocked Atlas warehouses in all the major industrial centres mean that all your tool steel requirements can be met from stock.

And Atlas has a comprehensive metallurgical service at your disposal too! Another reason why it's sound business policy to specify Atlas steel. It's as near as your telephone!

ATLAS TOOL STEELS

ATLAS STEELS LIMITED
Welland, Ontario

Warehouses: Montreal, Toronto, Hamilton, Windsor, Winnipeg, Vancouver

Representatives: London, St. Catharines, Sudbury

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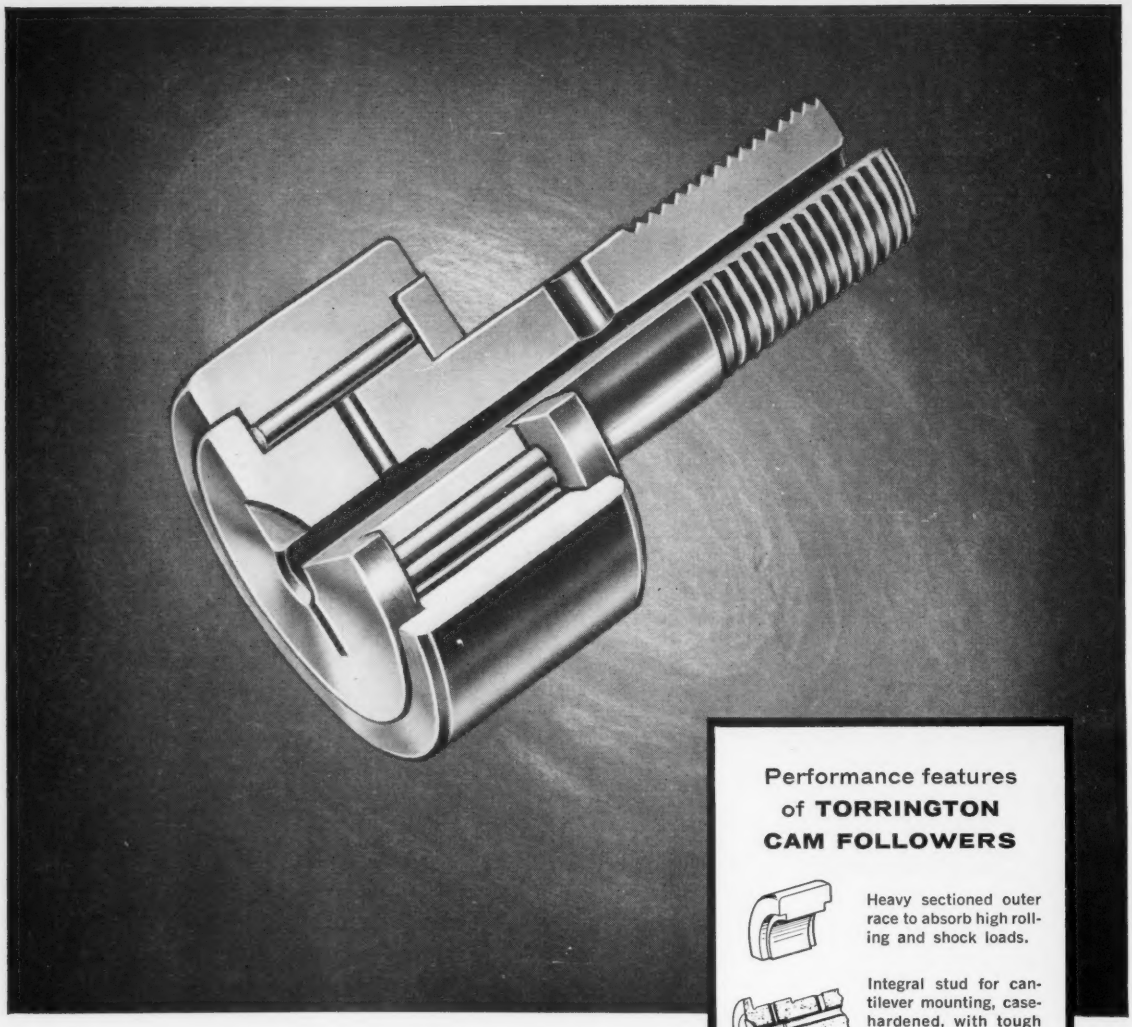
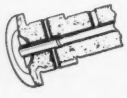


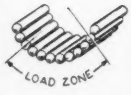
Performance features of **TORRINGTON CAM FOLLOWERS**

Heavy sectioned outer race to absorb high rolling and shock loads.

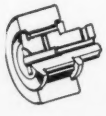


Integral stud for cantilever mounting, case-hardened, with tough core for high strength to withstand shock loads.

Easily relubricated at either end or through cross hole in stud. Ends accommodate standard drive grease fittings or plug seals.



Full complement of small diameter rollers for maximum radial capacity and efficient anti-friction performance.



Races precision ground for even load distribution and uniform low end play.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to insure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

Precision made throughout, Torrington Cam Followers are available in sizes from ½" to 2¼" OD. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for ultimate capacity. *The Torrington Company Limited,* 925 Millwood Road, Toronto 17, Ont.

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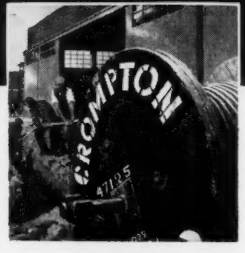


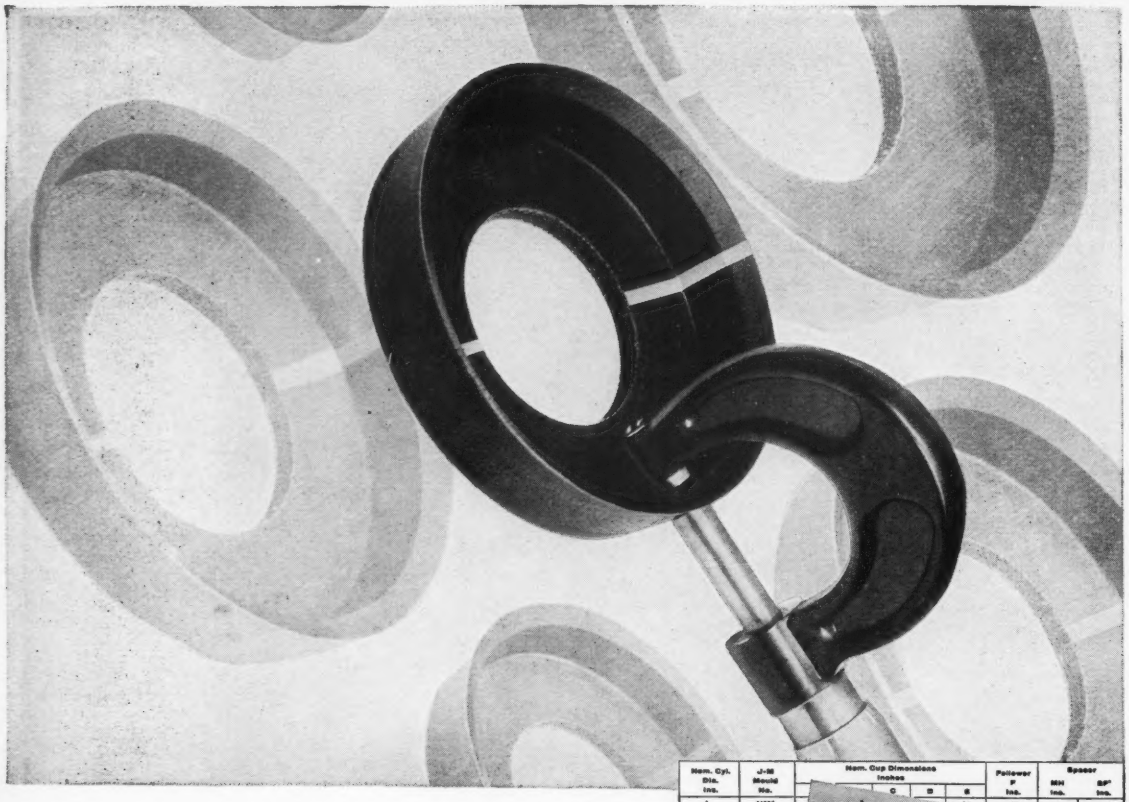
With 'Cable'— as with music — much depends on who makes it

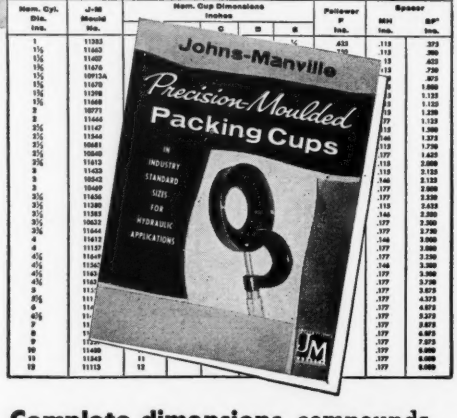
The score for the Pastoral Symphony is a detailed specification that is set down in a precise notation. Specific though the score be, its interpretation can vary considerably and that is why every discriminating music-lover looks for the name of the conductor before booking his seat for a performance. That is true of music, you may say; but surely cables can be specified completely? They can; but they still have to be made. In this case it is the almost intuitive competence — the know-how — which plays an important part. Competence in manufacturing grows with experience and that is why, when specifying cables, it pays to look for the name of a Company with a long history behind it.

FOR THE FINEST IN QUALITY AND PERFORMANCE CONSULT . . .

BEPCO CANADA LIMITED

Packing Cups in Industry Standard Sizes Precision-moulded by Johns-Manville





Ask for new size list and compound color code of these J-M Packing Cups

Made in the original *square heel* design, developed and perfected by Johns-Manville, these cups are precision made to assure maximum efficiency.

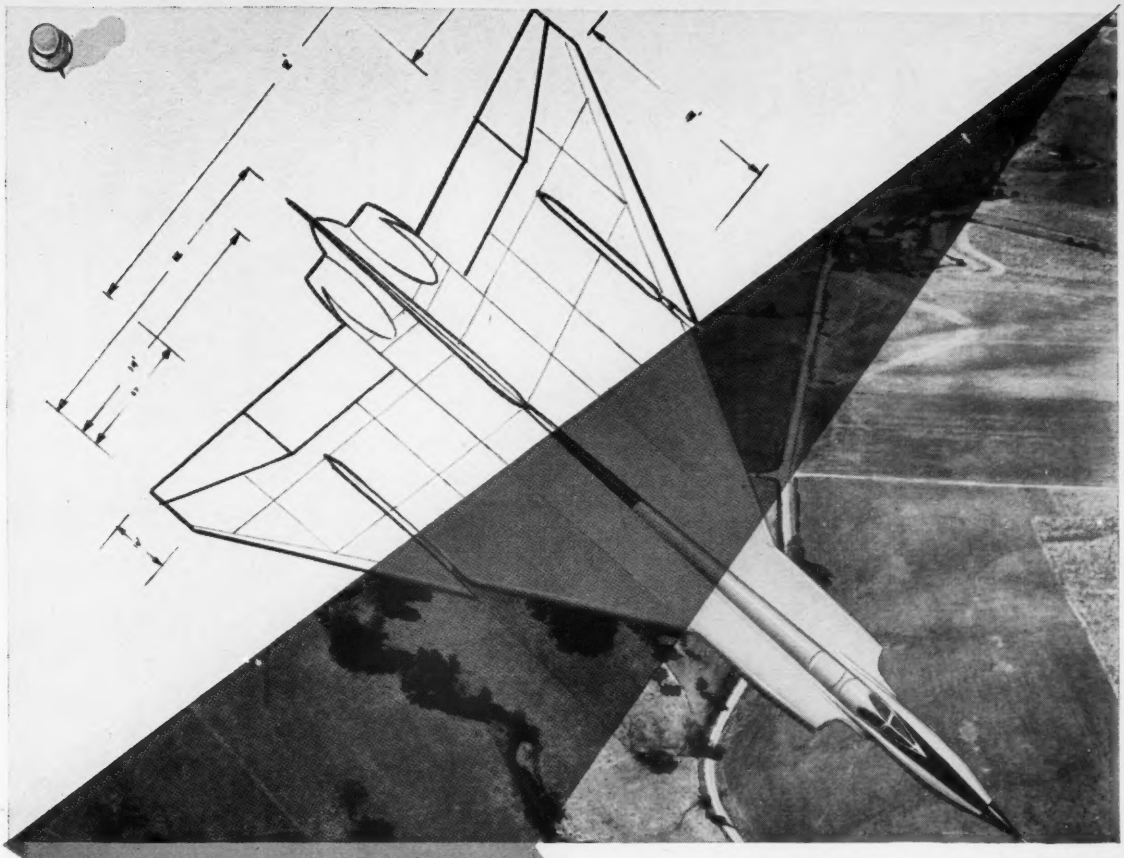
They are available in a variety of styles and compounds to suit most pressures, temperatures and fluids. For easy identification, cups are marked with a different color stripe for each compound.

Complete dimensions, compounds, code and piston design data are in folder PK-107A. Write Canadian Johns-Manville, 565 Lakeshore Road East. Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS, GASKETS and TEXTILES

1-213



The complex electrical generating system of the new Avro Arrow was designed and developed at LUCAS-ROTAX.

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with Lucas-Rotax creative engineering

From your concept to a functional reality . . . this transition calls for expert help!

Lucas-Rotax engineers can supply that help, drawing upon their company background of designing equipment into the finest engines and aircraft for the past twenty-five years.

In Canada, Lucas-Rotax alone has the breadth of experience and the manufacturing facilities to implement *your* engineering vision. Write or call us for further information. 5804-R

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Why vibramix?

"*Superior Results at Half the Cost*", says

Mr. H. P. Ruggles of H. P. Ruggles Co. Ltd., Hamilton, Ont.

When Mr. Ruggles decided to compete with much larger firms for the contract to manufacture this electrical switch gear assembly, he realized he would have to bid with *economy*.

Standards for electrical equipment are, and must be, very high. So they seldom allow for a startling performance differential.

But economy was another matter. From long pioneering experience, Mr. Ruggles held a trump card: VIBRAMIX! If the disconnect device could be molded with this economical 'wonder' material, the game could well be won. He knew that any part made of Vibramix would have excellent electrical and mechanical properties, including low moisture absorption and high heat distortion point.

And the contract proved him right. The English Electric Company which awarded the contract, has estimated a cost saving on the VIBRAMIX part alone of 35%, and a total saving of approximately 50%.

Why not see how Vibramix can serve you? For complete information and technical assistance, write or call Naugatuck Chemicals at Elmira, Ontario, or our branches in Montreal, Toronto, Winnipeg or Vancouver.

Other NAUGATUCK Plastics

Vibrin - Polyester Resins

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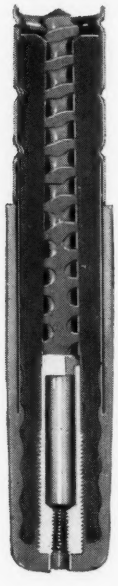
Naugatuck Chemicals

DIVISION OF DOMINION RUBBER COMPANY LIMITED

IMPACT PROBLEMS IN 4 DIFFERENT FIELDS SOLVED WITH Spaulding MATERIALS

Railroad Track End Post
made of Spaulding Vulcanized Fibre, combining impact strength with dielectric strength.

Catcher's Shin Guard made of Spaulding Vulcanized Fibre — impact strength plus versatile forming quality.



Lightning arrestor with Spaulding Vulcanized Fibre Baffle — impact strength plus high dielectric and machining qualities.

Rolling Mill Thrust Collar of Spauldite — impact strength plus resistance to wear and pressure.

SPAULDING FIBRE OF CANADA, LTD.
70 Coronet Road, Toronto 18, Ontario

All four of the objects shown at left must stand up to tremendous impact forces. Yet each of them combines impact strength with other unique and varying properties to do the whole job. That's why in each case the manufacturer used a Spaulding basic material.

Contact Spaulding when you have an application that calls for any or all of these properties:

- great mechanical strength
- light weight
- durability
- chemical inertia
- arc resistance
- low moisture absorption
- dielectric strength
- resistance to impact

A factory-trained Spaulding Engineer can help you select the right material and we will produce finished parts to your specifications.

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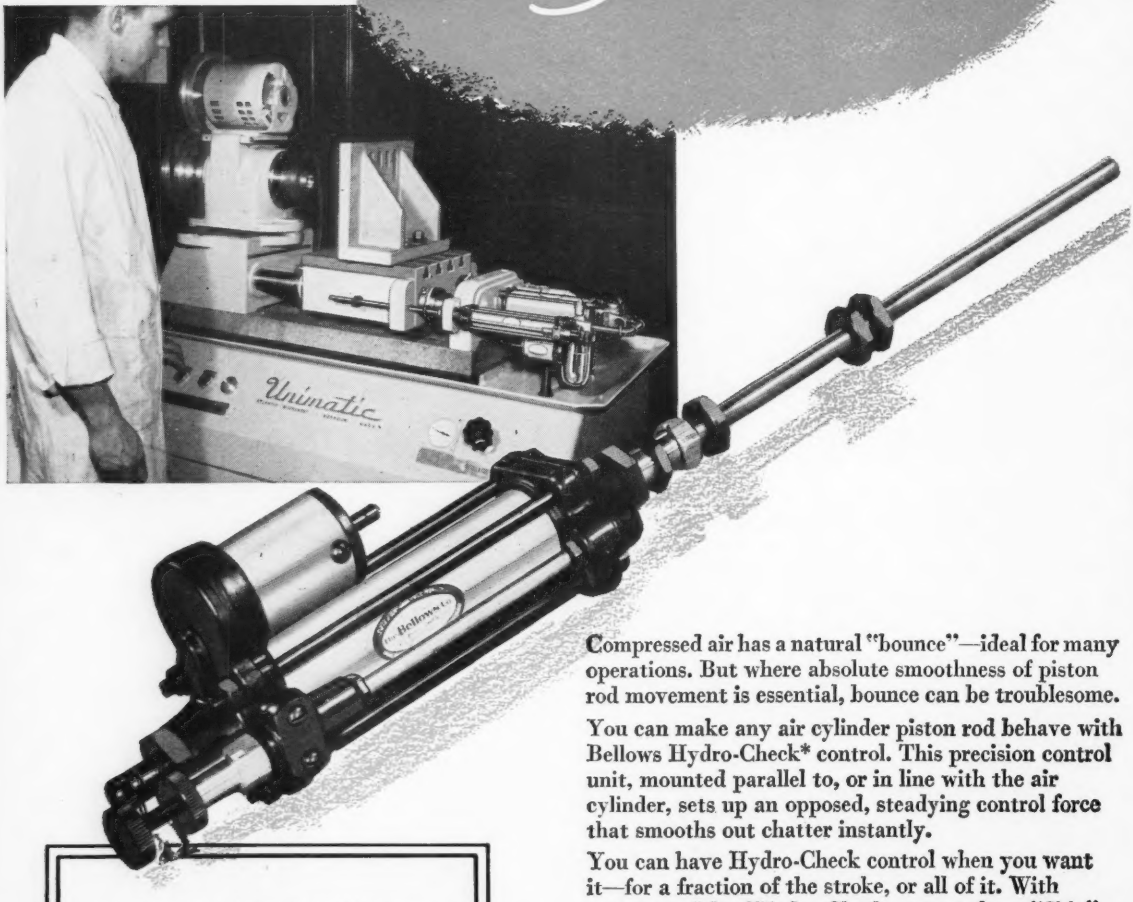
how to give any air cylinder...

Hydraulic Smoothness



Compressed air has a natural "bounce"—ideal for many operations. But where absolute smoothness of piston rod movement is essential, bounce can be troublesome.

You can make any air cylinder piston rod behave with Bellows Hydro-Check* control. This precision control unit, mounted parallel to, or in line with the air cylinder, sets up an opposed, steadying control force that smooths out chatter instantly.

You can have Hydro-Check control when you want it—for a fraction of the stroke, or all of it. With certain models of Hydro-Checks you can have "Skip"—or intermittent checking action; or you can stop an air cylinder piston at any point in its travel for a predetermined time and then resume traverse. Hydraulic control can be on either advance or retract strokes or on both.

*T.M.Reg.

If you use air cylinders in precision operations, you'll want to know more about Bellows Hydro-Checks—precision hydraulic control for air cylinder power. Write for Bulletin HC-602 Address: The Bellows Co., Dept. DE 658, Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd. 14 Advance Rd., Toronto, Ont.

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Backed by one of the world's largest Zinc producers, Tadanac Zinc is the preferred brand with alloyers and die casters who demand consistent high purity, assured supply and prompt delivery.

For information or assistance regarding Zinc die casting operations, contact our Technical Service Staff. Your inquiries will be given immediate attention.

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Everyone knows that in time the face of a city can get pretty grimy. Now it needn't . . . ever. That's the beauty of stainless steel construction. The bright, smooth surface on the outer wall of a building washes clean with every rainfall. Upkeep expense is negligible.

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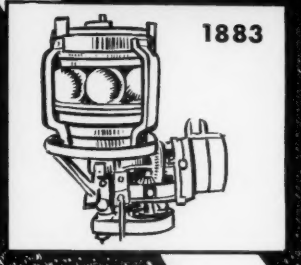

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BALLS BY AN AUTOMATIC PROCESS
HE WAS SOON KNOWN AS **KUGELFISCHER**
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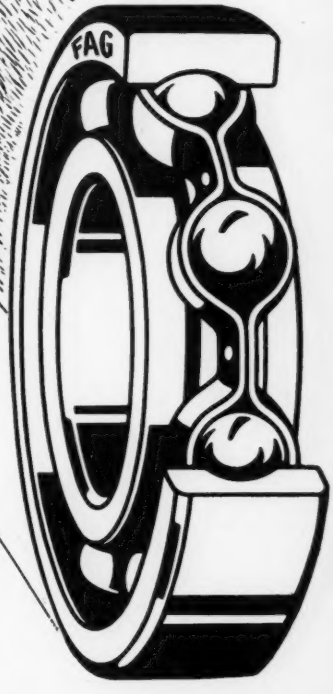

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TYPE 23

ELIMINATES TAPPING—
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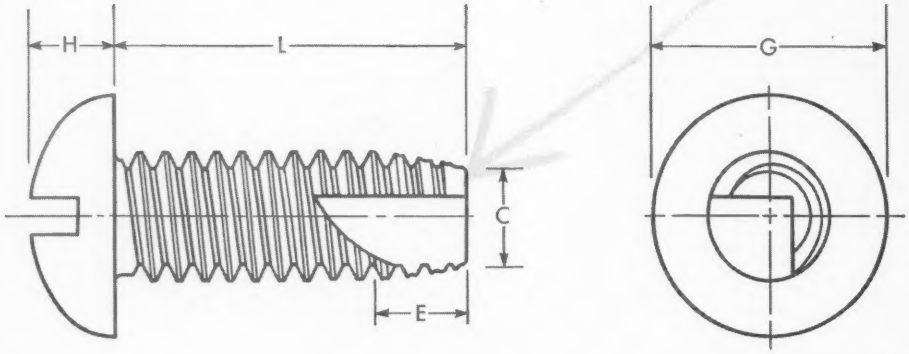

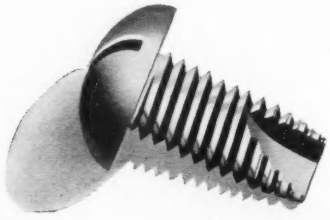

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FUNCTION: SHAKEPROOF Type 23 Thread-Cutting Screws cut perfectly mated threads in metal, die castings and plastics.

VARIATIONS: Type 1 Thread Cutting Screw has narrow slot and standard thread for certain hard metal applications; Type 25 for plastics has spaced thread and large cutting slot.

SPECIAL FEATURES: Pilot points, enamel-reaming points, double-end studs, headed shoulders. Thread-Cutting Screws can be pre-assembled with lock washers, fiber washers, flat washers, special stampings. Sealing compounds available.

HEAT TREATMENT: Special heat treating makes SHAKEPROOF Thread-Cutting Screws twice as strong as ordinary screws, often reduces the number or size of screws required.

REMARKS: Thread-Cutting screws reduce fastening cost as much as ⅓ by eliminating tapping operation. Ideal for use with automatic hopper-fed power screw drivers.

HEAD STYLES: All popular styles available including slotted, Phillips recess, hexagon and hexagon washer heads. Many special heads.

MATERIALS: Steel, stainless steel, aluminum, brass.

FINISHES: Cadmium plated, plain, parkerized or other finishes as specified.

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NOTE: Type 1 and Type 23 Thread-Cutting Screws cut a standard machine screw thread, can be removed and reused. Patented.

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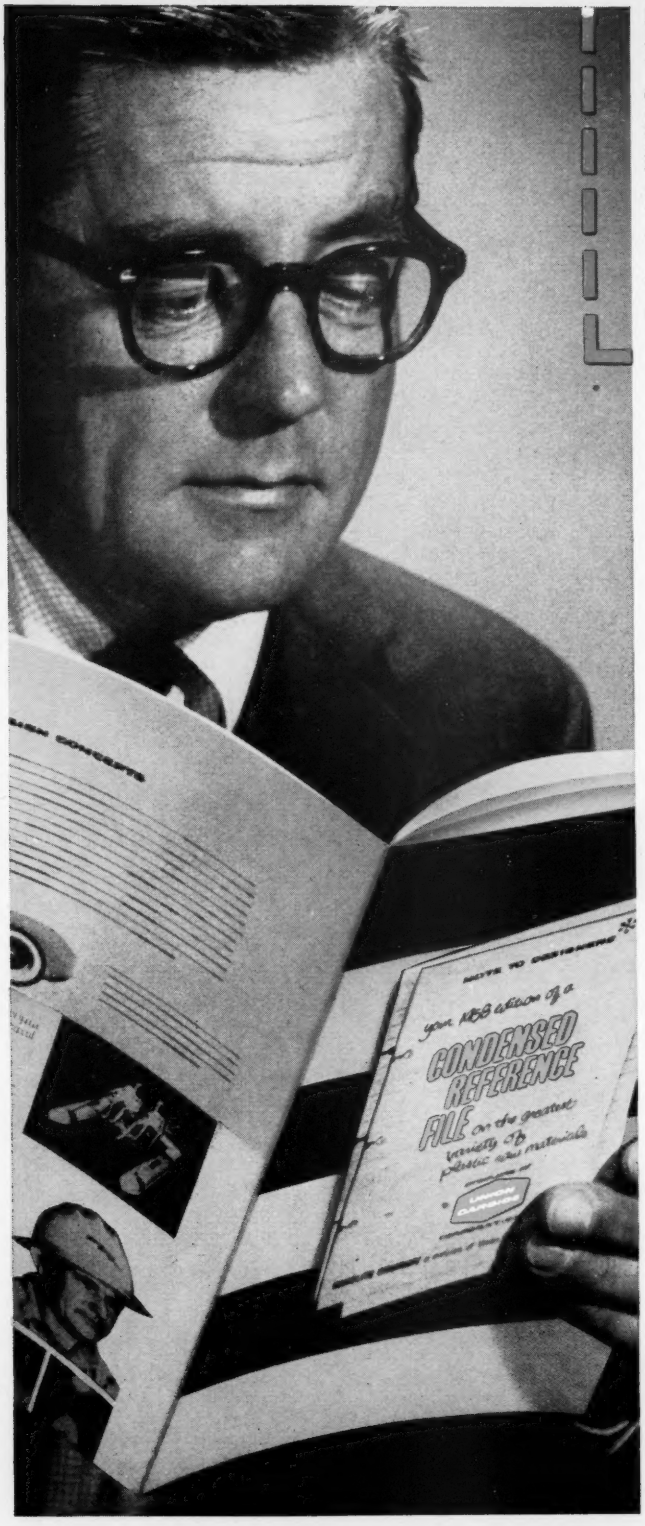

BAKELITE COMPANY
Division of Union Carbide Canada Limited
40 St. Clair Ave. E., Toronto 7, Ontario.

Gentlemen:
Please send me a copy of your 1958 Condensed Reference File that describes the plastics and resins produced by Bakelite Company.

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"BAKELITE" and "UNION CARBIDE" are registered trade-marks.

If you make it with steel, satincoat is best!

satincoat is a versatile zinc-coated steel that is ideal for an endless variety of fabricated products. It helps you to reduce your manufacturing costs and make a better product. For complete details, see your Steel Jobber or write Dofasco.

satincoat is available in a complete range of sizes and gauges, and in sheet or coil form.

- satincoat *resists rust—protects your product during manufacture —and long, long after.*
- satincoat's *rust-resisting zinc-coating will not crack or peel during forming or fabrication.*
- satincoat *takes paints, lacquers or enamels without surface preparation.*

Any stamping oils, greases, etc., picked up during processing will, of course, need to be removed before paint is applied. This is ordinary painting procedure regardless of the material used.

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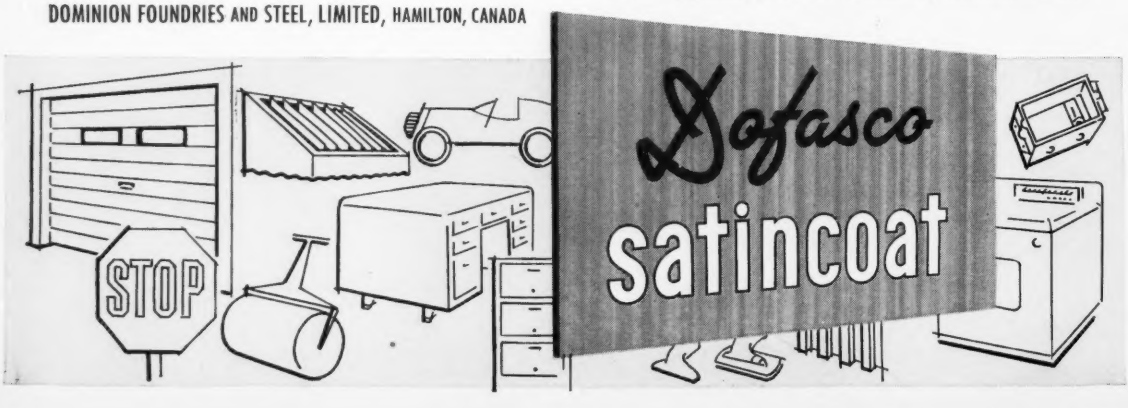

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90% asbestos yarn reinforced with 2 strands of inconel wire for corrosion resistance as well as maximum heat resistance.

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Here's an outstanding valve stem packing which is ideally suited to extreme steam conditions. Withstands pressures of 4000 psi., and steam temperatures to 1200°F. as long as stuffing box itself does not exceed 750°F. It is unsurpassed as a high temperature oil refinery or steam power plant packing.

This Style 127 Valve Stem Packing is the newest member of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals to meet all your needs. It's the only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him . . . ask about the new Style 127.

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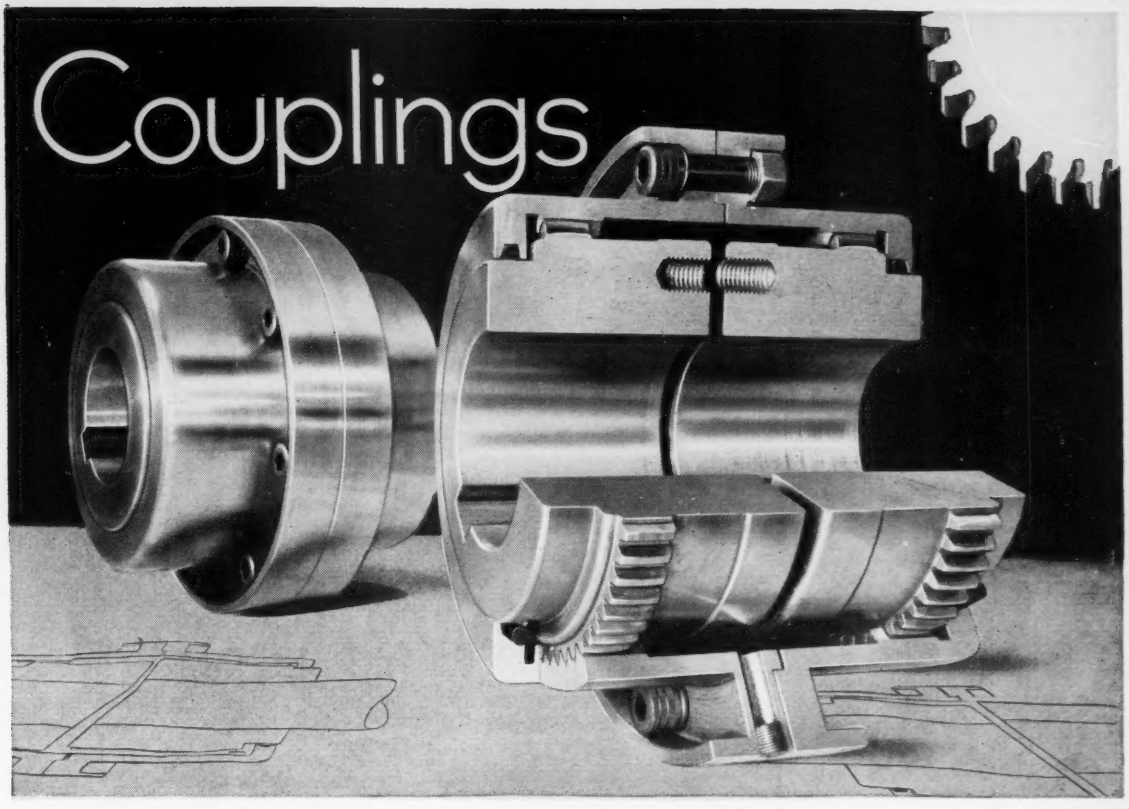

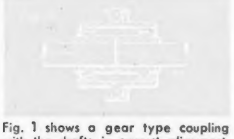

Fig. 1 shows a gear type coupling with the shafts in correct alignment.

Fig. 2 shows the displacement of the coupling where shafts are parallel but out of line.

Fig. 3 shows the gear type flexible coupling where the shafts are angularly out of line.

Fig. 4 shows the gear type flexible coupling coping with a combination of errors of alignment both angular and offset.

Hamilgear Flexible Couplings

HAMILGEAR flexible couplings are of modern compact design combining all the desirable features necessary to insure long trouble free operation and maximum load carrying capacity for all possible conditions of misalignment shown at the left.

Tooth flanks of the external teeth on the hubs are crowned to give a "barrel" shape. The amount of curvature is proportioned to balance the requirements of eliminating edge tooth contact when connecting misaligned shafts, and still assure maximum load carrying capacity with minimum tooth stress.

The internal gear sections are widely spaced to keep the angularity resulting from offset misalignment at a minimum.

Shear stress on the flange bolts is taken on the full bolt diameter rather than on the threaded portion.

Lubricant is retained in the coupling and dust and dirt excluded by oil resistant synthetic rubber "O" rings.

HAMILGEAR flexible couplings are available in stock sizes and types and special designs where required.

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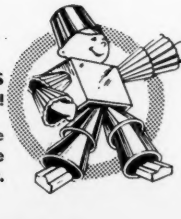

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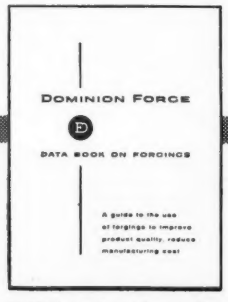
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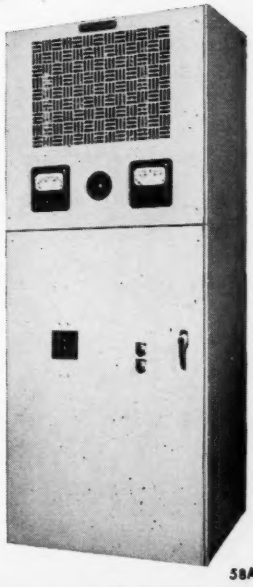

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The new Westinghouse Silicon Rectifier is gaining great favour in modern industry as the ideal DC-power source for many types of heavy machinery. Already two of Canada's largest steel companies have ordered Westinghouse Silicon Rectifier installations.

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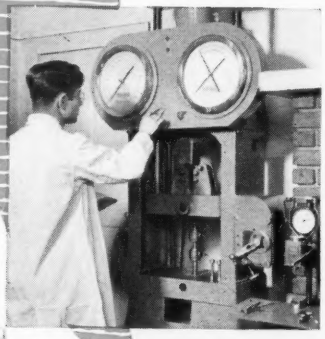

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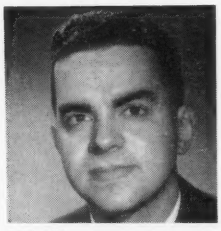
March-past

A news review of companies and people — functions and careers



PINARD

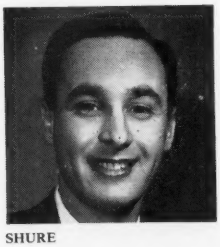
Arthur G. Pinard has been appointed manager, industrial products Dept., of Canadian Resins & Chemicals Ltd.

Mr. Pinard, who has been sales supervisor for resins and chemical products since October, 1956, was assistant to the manager, industrial products Division, for two years previously. He joined the company in 1945 following graduation from the University of Toronto.

CHAMBERS

Harold B. Chambers has been appointed vice-president, metallurgy, of Atlas Steels Ltd. He will continue to head all metallurgical functions within the organization. Included in his responsibilities are metallurgical research and development, product development, process and service metallurgy, market development, as well as chemical and physical laboratory control. He will also function as part of the company's management committee.

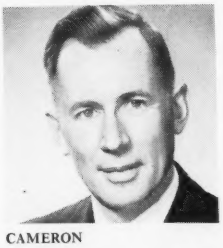
Mr. Chambers, a metallurgical engineer, is a graduate of Lehigh University and served in the U. S. tool steel industry for several years before joining Atlas in 1931. He is a naturalized Canadian.



SHURE

Harold A. Shure has been appointed a technical sales representative (plastic resins) for Naugatuck Chemicals. Mr. Shure brings ten years of plastics experience in the United Kingdom to his new position. He is a member of the Plastics Institute of Great Britain, and is also a graduate of the plastics course of the West Coast University at Los Angeles, Calif., which he attended while on leave of absence from his employment in England.

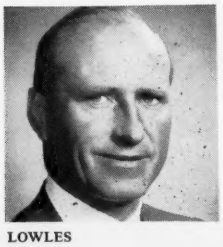
Specializing in Naugatuck Chemicals' polyesters, polyester premixes and styrene copolymers, Mr. Shure will be based at Naugatuck's Toronto branch.



CAMERON

Adam K. Cameron has been appointed manager of the Fabrikoid division of CIL at New Toronto. He succeeds W. H. Shaw who has been named special assistant to the Division's general manager.

Cameron, who is a native of Quesnel, B.C., is a McGill University graduate with a B.Eng. degree. He joined Defence Industries Ltd. in 1941 and transferred to CIL in 1944. Since then he has had engineering posts in Montreal and Toronto and came to the company's New Toronto plant in 1951. He was appointed assistant works manager two years later.



LOWLES

International Nickel Research & Technical Services Ltd., has announced the opening of its Montreal office. Designed to keep pace with growing industrial expansion in Quebec, the Maritimes and Newfoundland, the company will provide technical information and fabrication advice for users of nickel and nickel alloys in these areas.

G. A. Lowles, a native of Montreal and a graduate in chemical engineering from McGill, has been placed in charge of the new office.

Two north-of-the-border winners

Winners of twenty-two international education awards for 1957-58 in the $12,000 scholarship program sponsored by ASTE have been announced.

The 40,000-member society annually presents ten international education awards of $700 each to outstanding engineering students in colleges and universities to aid in their third or fourth year of studies in tool, production, mechanical or industrial engineering. This year, for the first time, twelve technical institute and junior college students also received awards of $400 each to further their second year studies. We note with pleasure that two of the award winners were from Canadian universities.

Du Pont forms plastics division

The formation of a Plastics Division with J. H. Childs as manager, J. L. Macdonald as sales manager, and F. G. Rice as market development manager, has been announced by Du Pont of Canada.

The new organization will form part of the chemicals department and will be responsible for all sales of the company's plastics materials including low pressure polyethylene resins, "Zytel" nylon resin, "Alathon" polyethylene resins, "Lucite" acrylic resins, "Teflon" fluorocarbon resins, and "Butacite" sheeting for safety glass.

Paper on smelting gets award

Professor H. U. Ross, department of metallurgical engineering, University of Toronto, was the recipient of the "Journal of Metals" award of the blast furnace, coke oven, and raw materials committee of the American Institute of Mining, Metallurgical, and Petroleum Engineers in Cleveland, April 15. The committee is a unit of the iron and steel division of the metallurgical society of AIME. The award was conferred for his paper, "Smelting of titaniferous ores."

Weld expert for Westinghouse

The appointment of Harry Thomasson as consulting engineer, Canadian Westinghouse Company, has been announced.

Formerly manager of the mechanical-metallurgical section of the laboratories, Mr. Thomasson will be engaged in special technical assignments and available to all divisions of the company.

Thomasson has established an international reputation and was the first Canadian ever to win major honors from the Lincoln Arc Welding Foundation. He has been honored twice by this organization.

In 1957 he represented Canada as delegate and speaker at the Commonwealth Welding Conference in London, England, and the International Institute of Welding Congresses in Germany.

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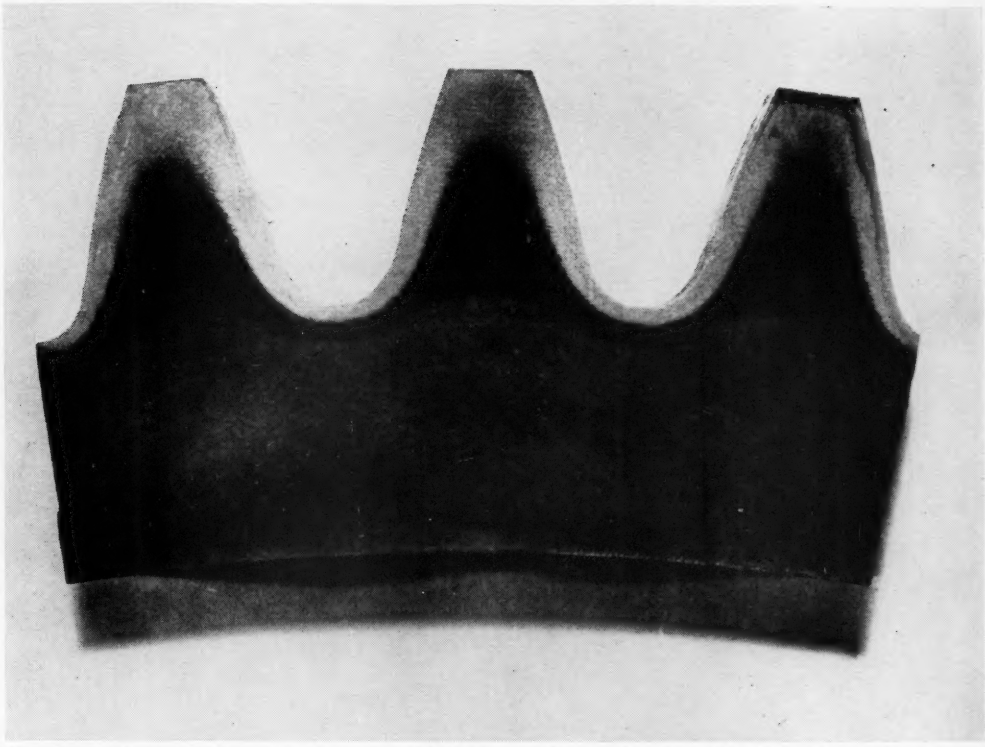


Note the tough core and wear resistant case (55 Rockwell "C") produced on this 28 in. dia., 5 in. face gear.

Magnetic field hardens surface skin

Induction heating applications are finding a growing acceptance

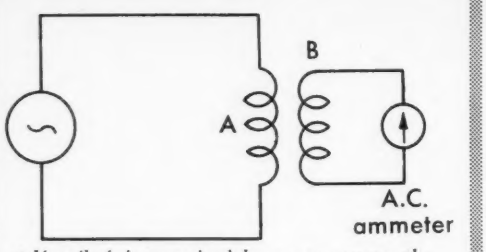
If a metal heating problem exists in hardening, forging, brazing or some other similar operation, it is more than likely that induction heating can do the job in less time, occupy less floor space and cost less to run than any other heating process.

Everyday, new uses are being found for induction heating and its acceptance in Canada may be gauged from the fact that one manufacturer alone has installed and is operating at this time in Ontario several thousand kilowatts of high frequency motor generator equipment and associated work handling fixtures.

John C. Lewis TOCCO INDUCTION HEATING

In the induction heating process, an alternating magnetic field is produced by the passage of an alternating current through an "inductor" of suitable shape and size. When the work to be heated is placed within this field, induced alternating currents flow in the work, producing heat. The principle is the same as that in a transformer: the inductor acts as the primary and the work as the secondary.

There is a tendency for the induced alternating currents to flow near the surface of the work, a tendency which is more pronounced as the frequency is increased. A very high frequency will produce a very thin heated skin at the surface of the work; lower frequencies affect a somewhat deeper zone. Any heating of the inner regions of the work is, however, wholly by heat conduction from the heated



If coil A is energized by an ac source, the flux produced is changing continually and an alternating current is produced in B. Note that B can be a single turn coil, a shorted ring or even a cylinder.

skin, and for this reason the selection of the optimum supply frequency is an important consideration for any application that is being studied. Equipment is available capable of generating and using power at frequencies ranging from 60 to several million cycles per second.

Perhaps the most widely developed application of the process is in the **surface hardening** of carbon steel components. Here, the power input to the work is very high, and the surface layers reach the hardening temperature in a few seconds. Since there is little time for heat conduction to take place, the inner regions of the work are unaffected. The immediate application of a quench results in a hardened surface layer, and a soft, but tough core.

When long cylindrical components are to be hardened, they are fed progressively through an inductor and an associated quench. In this way, only a small part of the surface of the work is heated at a time, and large components may be hardened with little distortion and relatively lower power. Standard handling fixtures are available, capable of holding shafts with a wide range of diameter and length, and rotating them as they are passed at a predetermined speed through the coil.

A dramatic example of the savings inherent in the process is the use of induction heating to harden mill rolls. These were previously carburised, hardened and tempered in a 28-hr cycle. The rolls were of 12 in. diameter, 60 in. long. When a carbon steel was specified, the rolls were fully surface-hardened in just 30 min. using induction heating. A saving of $28 per roll resulted from the change in heat treatment and, even more acceptable, grinding time was halved due to the greatly reduced distortion. This produced a saving of more than $80 per roll.

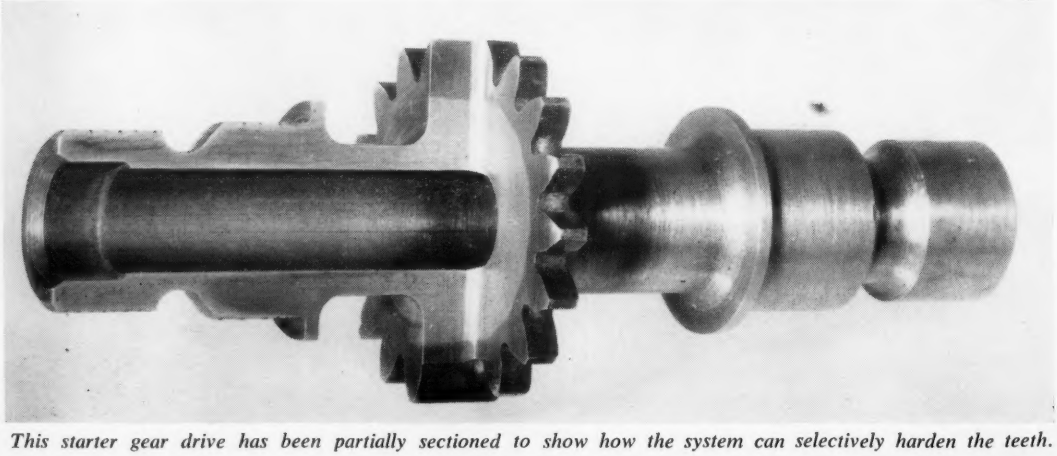
Another advance on traditional methods is illustrated by the hardening processes carried out as part of the machining cycle on multi-spindle automatic machines. In one installation, a suitably shaped inductor heats the inside diameter of automotive trunnion cups after they have been machined. The inductor and associated components are mounted at one station of the machine, quenching being carried out by the application of the standard cutting lubricant used on the machine. The heating and quenching cycles occupy about 10 sec per part, using SAE 1144 steel. Often considered a high production tool, induction heating has its place in the treatment of small batches of work. With simple hand-loaded fixtures, change over times are short and power settings readily reproduced.

For very thin cases (.20 to .030 in.) on small diameter work (or on thin-walled tube) frequencies as high as 450,000 cps are specified, but, with a few exceptions, the process is carried out at frequencies between 3,000 and 10,000 cps. The equipment required to furnish the high frequency power is generally easier to use and more efficient and reliable at these lower frequencies.

Forging. There are several advantages in using induction heating for raising billets and bar stock to the forging temperature. For ferrous materials, the most important is the virtual elimination of heavy scale from the heated stock.

The absence of this abrasive material has resulted in 4 times the forging-die life. As the heat is developed within the work itself, it is possible to reach the forging temperature in a very short time, without overheating the surface and with very small temperature gradients through the section. A bar of 1 in. diameter attains the forging temperature in approximately 10 sec.

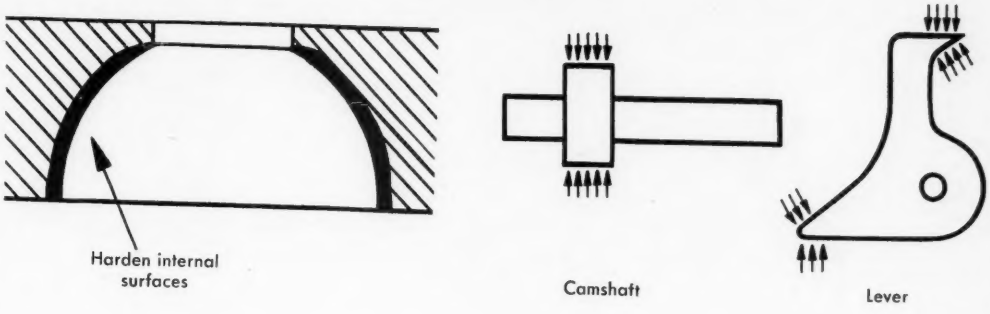
A further advantage lies in the application of the heat, so that only part of the billet (or bar) is heated, or so that an exactly controlled gradient along the length of the stock is obtained. This gradient heating is made



This starter gear drive has been partially sectioned to show how the system can selectively harden the teeth.

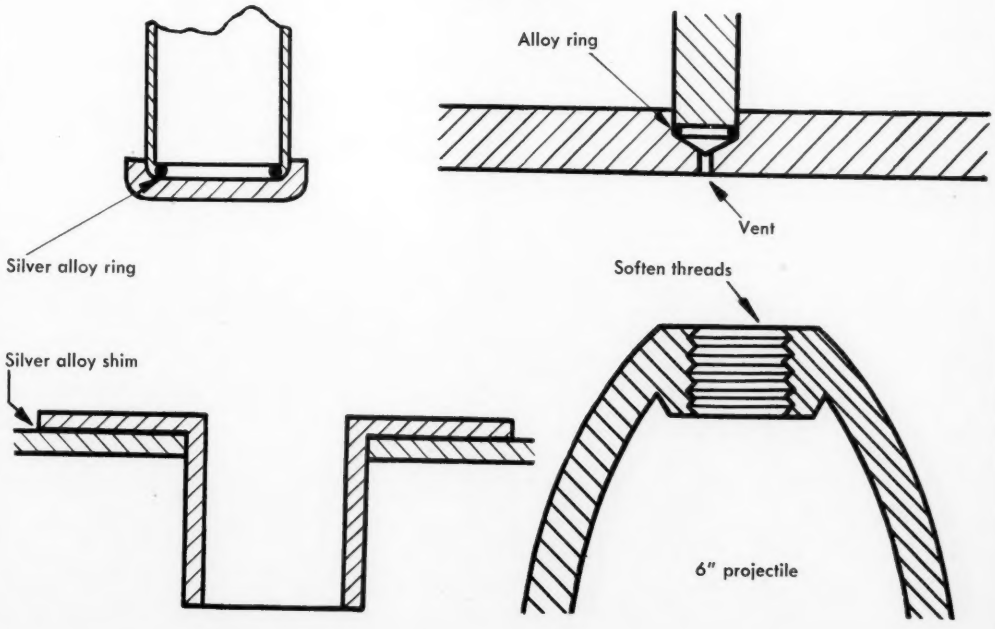
Typical applications of induction heating

Hardening



Forging and upsetting

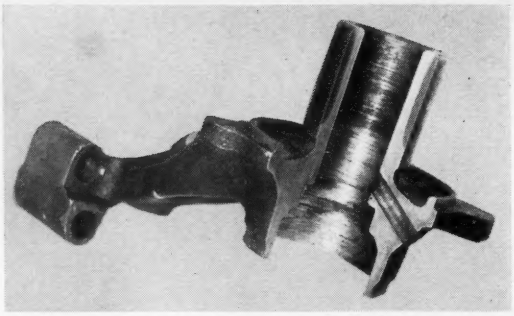
Brazing



use of in the aluminum extrusion process; for aluminum billets of greater diameter than 6 in., 60 cps power from the plant supply may be used.

When heating steel billets to the forging temperature (around 2,200 F) with 60 cps power, the minimum diameter of stock that can be heated with reasonable efficiency is about 14 in., but as the heating efficiency is high when the steel is magnetic, 60 cps power can be used to heat work as small as 4 in. diameter to about 1,400 F. The work is then raised to the final temperature by a higher frequency power source operating at 3,000 or 10,000 cps. Temperature control at these high temperatures presents little difficulty, for several industrial control manufacturers supply radiation pyrometers for this purpose. These instruments control the output of the motor generator equipment and are able to maintain temperatures as high as 2,250 F within 25 F.

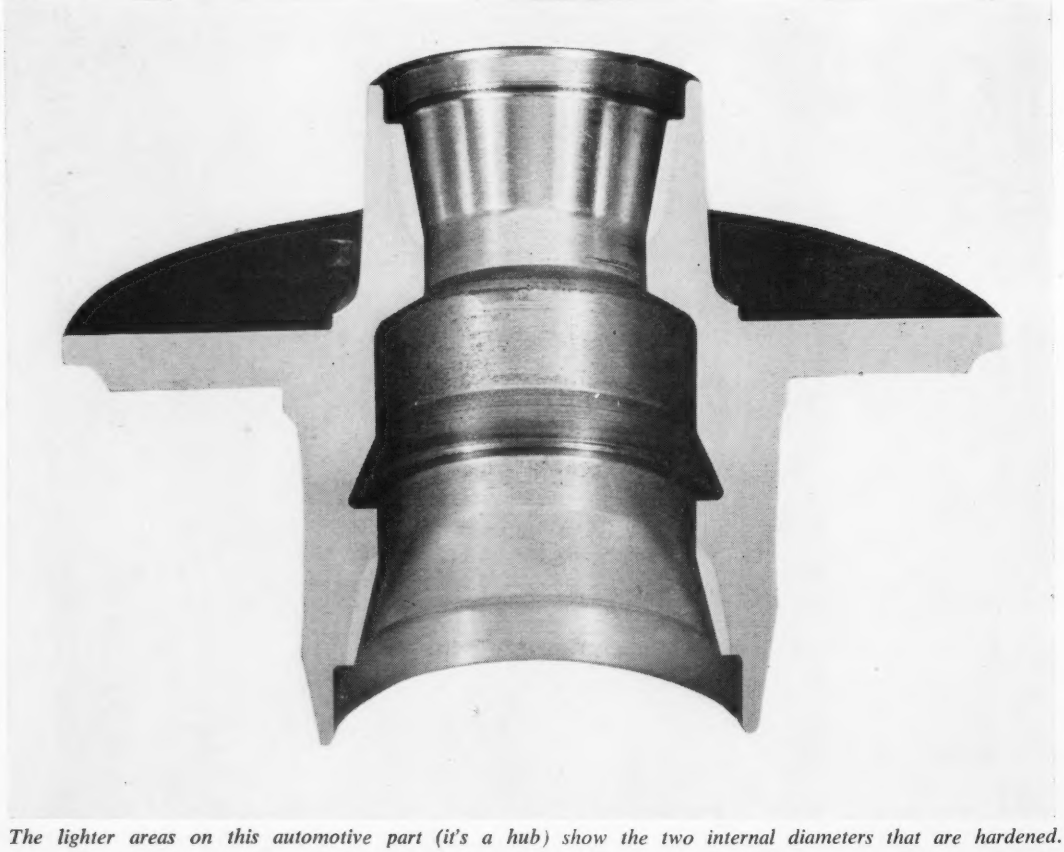
Savings in man-power follow naturally on the introduction of induction heating to the forge shop, for one man is often able to operate both the forging hammer and the heating equipment. Nor is special skill required: anyone who can load the parts into a fixture can use the equipment. For the best in working conditions, freedom from fumes and radiant heat, a carefully controlled temperature and a high production with a minimum of maintenance, induction heating is unexcelled.



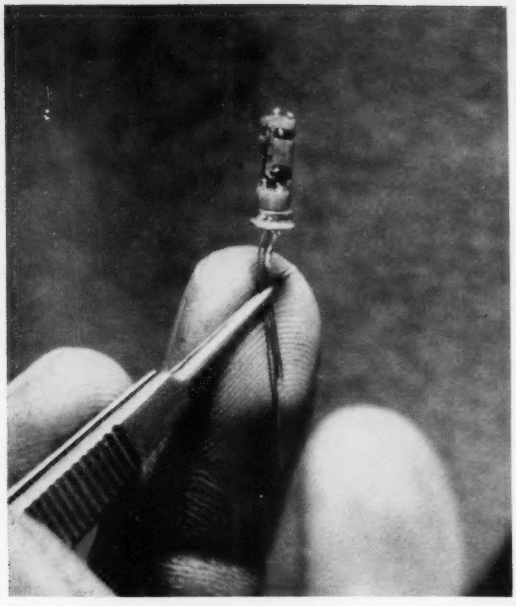
Hardening time for this part was just eleven seconds.

Joining by brazing and soldering. When induction heating is used in brazing or soldering, the joining material is pre-placed at the joint (before heating is commenced) in the form of wire rings or shims. The even heating of the joint area leads to the production of sound joints of attractive appearance. A reduction in distortion and post-operation cleaning are other benefits to be expected.

An outstanding use of induction heating for brazing is in carbide cutting tool manufacture. The even heating and absence of hot spots greatly simplifies the brazing of the brittle carbide inserts. In addition, the ability to localize the area of heating is a great advantage when multi-tipped tools, such as milling cutters or reamers, are to be made. ★



The lighter areas on this automotive part (it's a hub) show the two internal diameters that are hardened.



The thermometer as it appears with the case removed.

Thermometer with "outer space" qualifications

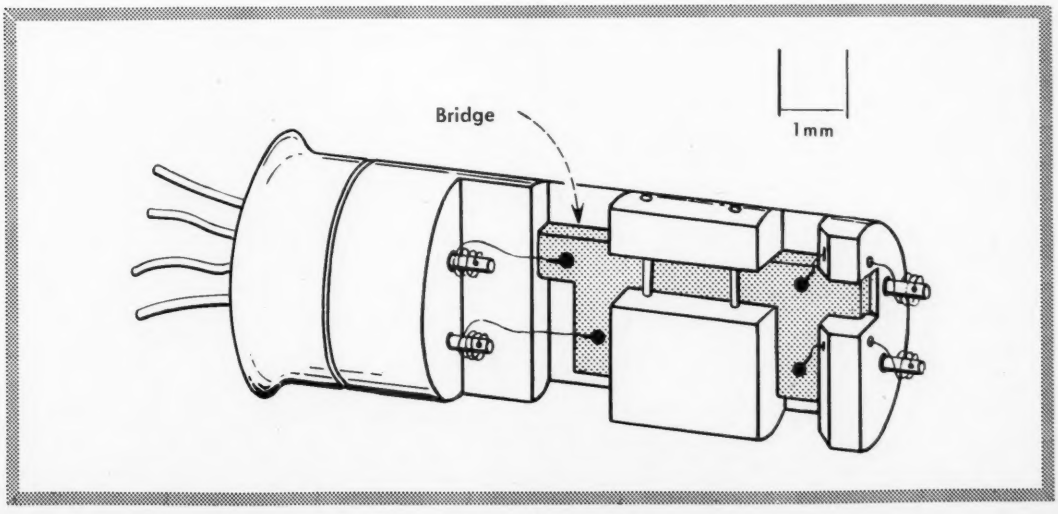
Gunshot size with super accuracy

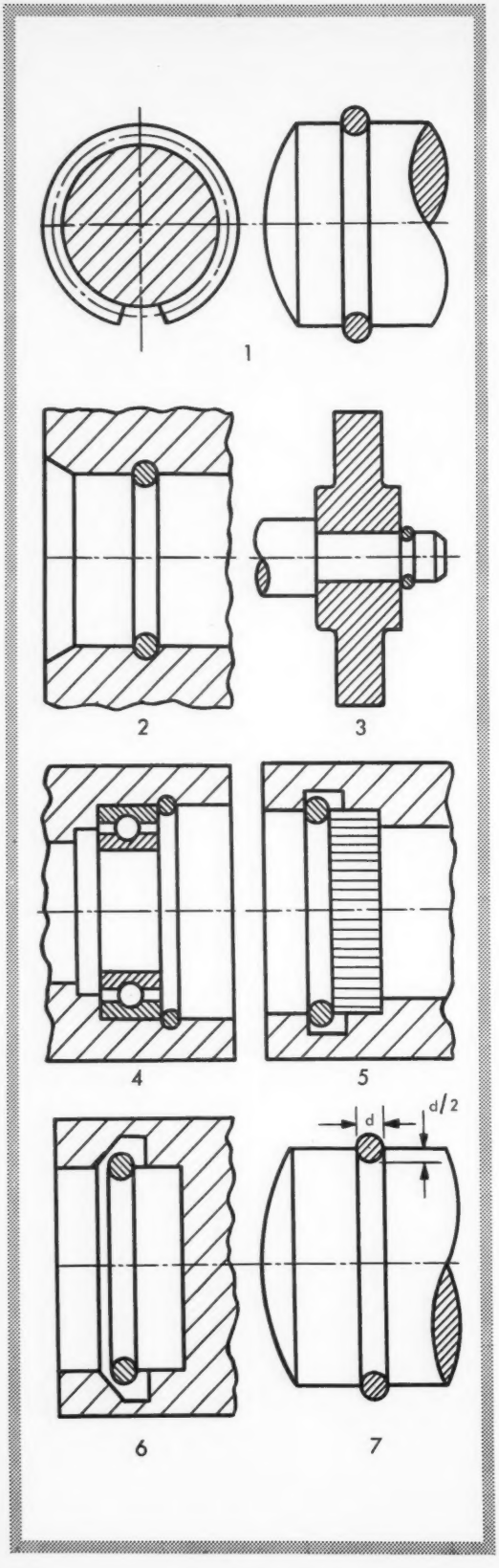
A germanium resistance thermometer (having high sensitivity and exceptional stability in the temperature range near absolute zero) has been developed by J. E. Kunzler, T. H. Geballe and G. W. Hull of Bell Telephone Laboratories. Once calibrated, the thermometer is reproducible to better than a few ten thousandths of a degree at the boiling point of helium (4.2K), even after repeated cycling from room temperature. Such characteristics indicate that this thermometer might be useful for the accurate measurement of temperatures in outer space, when mounted in a suitable space vehicle.

The heart of the thermometer is a very small "bridge," cut from a single crystal of arsenic-doped germanium. The actual size of this bridge is about 0.025 x 0.020 x 0.210 in. Current and potential leads are attached to the bridge, and it is supported (in a strain-free manner) in a platinum-glass enclosure containing a small amount of helium gas to aid in thermal conduction. The resistance is determined by measuring the potential drop when a small (about 10 microamp) current is passed.

Germanium can be doped with arsenic to produce a high and fairly constant temperature coefficient of resistance at temperatures near the boiling point of helium. For example, a typical thermometer made at Bell Laboratories had a resistance of about 1.0 ohm at room temperature, 14 ohms at 10 K and 216 ohms at 2 K. Both the temperature coefficient and the actual resistance vary widely with minute changes in the amount of doping, making it possible to have a thermometer with a wide range of characteristics. Such a thermometer will retain its calibration from 300 K to 1K.

To avoid excessive heating when measurements are being made, the resistance of the thermometer should be kept as large as possible. For simplicity in application, however, a compromise can be reached by controlling the doping of the germanium crystal. ★





When to use a snap ring—which one to use

They're small and simple but can play an important part in securing, assembling and in fastening

Federico Strasser

Snap rings are small, simple, light, cheap machine elements extensively used in automobiles, machine tools, textile and other machinery, electrical and mechanical gadgets, toolmaking and so on. They are employed chiefly for assembling, fastening or securing the axial position of machine components (bearings, bushings, gears, pistons, links, pulleys, pins, etc.) on shafts or in housings. Snap rings are always located in suitable grooves, machined in the corresponding retaining counter-workpieces.

There are two basic types of split ring applications: (a) external rings for shafts (Fig 1) and (b) internal rings for housings (Fig 2). The external ring is mounted on its shaft so that it is opened until it can be slipped into its groove. The ring (in its working position) is under expansion, the maximum tensile stress being at the inside.

The internal ring, on the other hand, is closed and then pushed into an opening in the housing, until it snaps into its corresponding groove, where it expands. In this case, the ring is under compression, the maximum tensile stress being at the outside of the ring.

Snap rings are usually made from carbon spring steel of round, square or rectangular cross-section. They are hardened and drawn after forming, or made from wire hardened from the cold-drawing process.

Figs 3 & 4 show typical examples of design with snap rings. From these it is evident that their great advantage is that they demand very little space. Consequently, the over-all dimensions and weight of the product is smaller. On the other hand, they cannot resist high axial loads and so must be employed only when the axial load is small.

Figs 5 and 6 illustrate an interesting application for indirect fastening of a disc in the interior of a housing. Fig 5 is not quite correct, for in this case some slight axial play of the disc is unavoidable. The design of Fig 6 is all right, however, because the disc is always firmly pressed against the shoulder in the housing.
Snap ring selection: Snap rings cannot be employed arbitrarily: there is a rather strict procedure for the determination of the correct ring size for every application, that is, for every shaft or housing bore diameter.

In fact, for the best results, the depth of the groove (Fig 7) must correspond exactly to the wire radius. If it is greater, the machine component to be fastened may slide over the ring: if smaller, the ring may come out of the groove under the slightest axial load.

Since the ring must be mounted on the shaft by slightly opening it (so that its expanded internal diameter corresponds to the shaft diameter, as in Fig 8), the total deflection of the ring in the middle must correspond to the wire diameter "d" (or "h," the thickness in the radial direction, if the wire is of rectangular shape). According to Tool Engineers Handbook, section 110, page 1836 (see Fig 9), the maximum admissible deflection is calculated by the formula:

$$F = \frac{Sd}{EK} \quad \text{or} \quad K = \frac{Sd}{EF}$$

S = maximum admissible stress (not more than 200,000 psi)
E = modulus of elasticity (about 30 x 10^6 psi)
K = a coefficient of correction governed by the D/d or D/h relation
D = mean diameter of the snap ring (when unloaded).

Substituting in this formula F = d and putting for S and E the numerical values quoted above, we obtain for K the value of 0.0066. This value corresponds to a D/d ratio of about 14.

This means that, in order to avoid permanent set of the snap ring whilst mounted in place, the wire diameter corresponds to the shaft diameter, as in Fig 8), should be about 7% of the mean diameter D of the ring.
Precautions: It is absolutely necessary, when mounting snap rings, to apply just the right pressure. If the ring is opened (closed) too much, permanent-set will result.
Special shapes for snap rings: When there are no space limitations, the snap ring may have other shapes than the plain, circular one. Two of the most important special shapes are shown. The triangular ring of Fig 10 allows much greater groove-depths than the plain round ring (groove depth may be equal to wire diameter) and thus the strength against axial loads is notably increased.

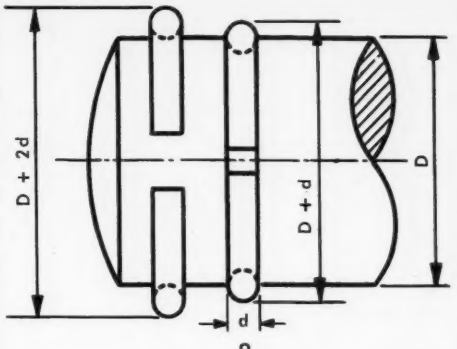
There are applications where it is not possible to mount the ring axially, but the assembly must be done radially. In these cases, the snap ring cannot have the classical, simple circular shape of Fig 1, but must be formed in some special shape. Fig 11 shows a double-ring which (due to its increased elasticity) is easily mounted and dismounted radially. The groove depth may be more than the wire radius.

For these two special snap rings the following dimensions have been found correct in actual practice, for small diameter shafts up to ⅝ in.:

(a) triangular rings (Fig 10)
$d = 0.07\ D$
$D_2 = 1.6\ D$

(b) double rings (Fig 11)
$d = 0.15$ to $0.20\ D$
$D_1 = D - 2d$
$D_2 = 2D$

★



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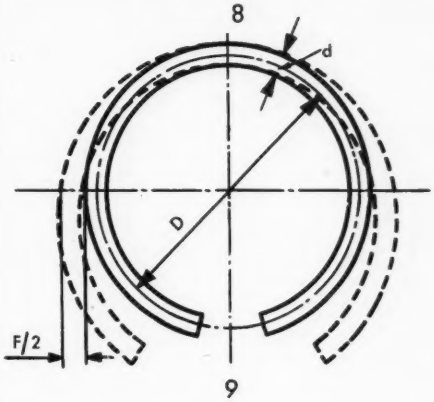

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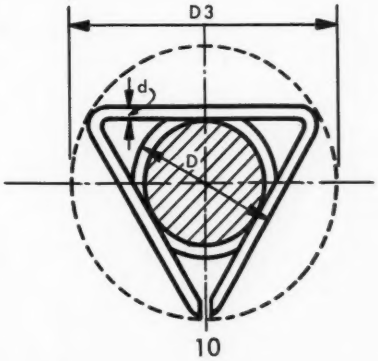

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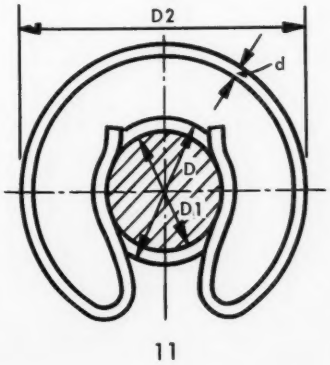

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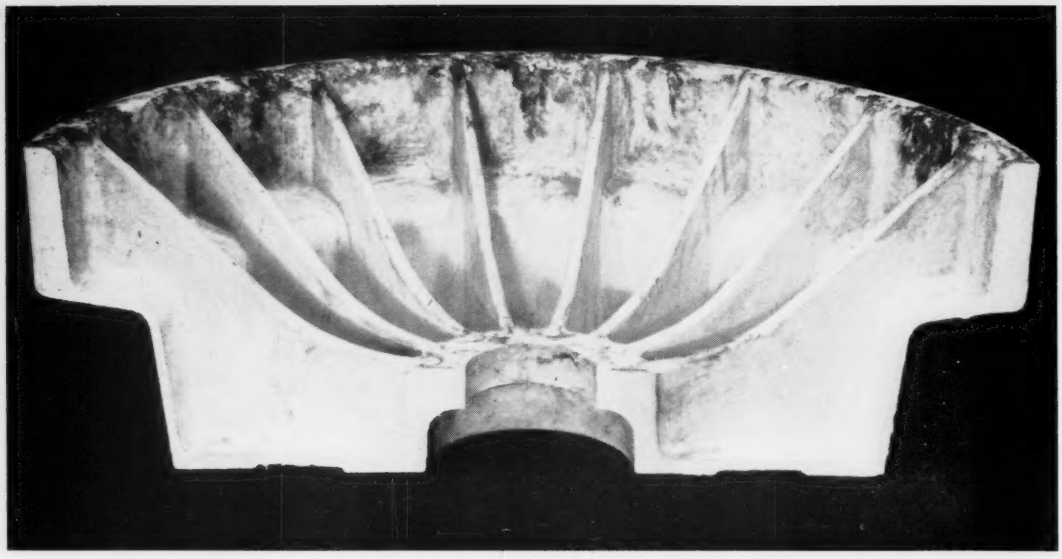


A plastic wheel cuts unsprung weight

A glass-reinforced polyester premix molding was the chosen material

Because of the difficulties of redesigning heavy metal wheels to cut down excess unsprung weight, it was considered a good idea to use plastics for the wheel of a track-laying vehicle. The initiative for the project came from the Army's Directorate of Vehicle Development (now part of A.D.E., the Army Development Establishment).

A glass-reinforced polyester premix molding was chosen because of its good strength-to-weight ratio and low temperature properties.

The staff and experimental facilities at Ontario Research Foundation were known to A.D.E. and they were consequently entrusted with a contract. This called for the design of the wheel and for managing and co-ordinating all phases of the project. The contract called for prototype production, which meant full-size wheels.

It was considered advisable to contact a plastics molder with experience in premix compounds and with adequate equipment. The design and manufacture of the wheels were consequently carried out in close co-operation with H. A. Gadd, manager, Engineering Plastics Section, Canadian General Electric Co. Ltd.

Readers who require further information than that given in this article should circle Reader Service Card No. 211.

V. S. Ristic, P.Eng. ONTARIO RESEARCH FOUNDATION

General considerations as to the best possible shape to use for the wheel boiled down to two:

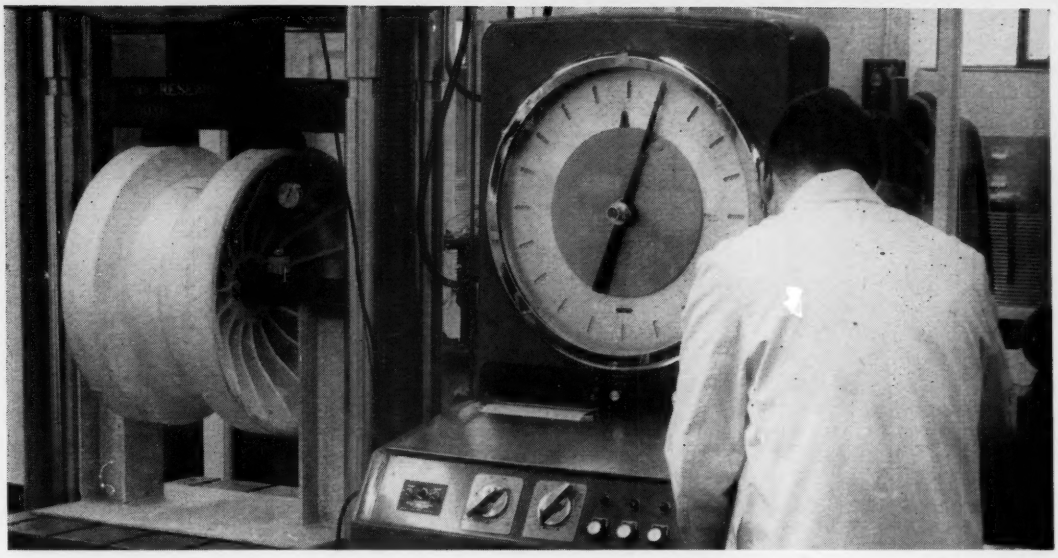
(1) Shell type
(2) Paddle-wheel type

The shell type (Fig 2) was the neater and lighter design. Elasticity, resilience, uniform stress distribution, minimum chance of stress concentration, all offered excellent structural advantages. However, the technical difficulties in molding such parts proved too much, and this design was abandoned.

The paddle-wheel type (Fig 3) is essentially a columnar structure. The paddles (or spokes) act as members in compression. The rest of the design has to take care of the functional aspect of the hub and the rim, the geometry of the whole assembly and the problem of how to join the two parts.

Once the paddle-wheel type was adopted as the main idea, the real design problem started. We had to decide on the dimensions of the hub, the number and thickness of the spokes, the thickness of the rim and so on. Due to manufacturing considerations it was decided to make the wheel in two identical halves and glue the dish-shaped moldings back to back to form the complete wheel.

The hub. The 5-in.-long hub (See Fig 1) has to carry a 3,000 lb radial load and a 3,000 lb axial load, plus the bending moment of 3,000 x 7.5 = 22,500 lb in. It has to be as strong as possible. The time required for curing put a limit on the hub cross-section thickness. The present hub, then, is a compromise. It is the best cross-section, bearing in mind ease of molding.



The spokes. Three factors entered the decision on the number of spokes:
(a) Lightness. Optimum use of material; cross sections with minimum thickness.
(b) A few very large spokes would have left a large gap between the spokes at the rim, thus weakening the rim. A lot of thinner spokes would have made mold-making difficult, without offering any structural advantages.
(c) The thickness of the spoke is the width of the slots in the female part of the mold. Minimum width (permitting unobstructed flow of the premix material) was anticipated to be ¼ in. If these spokes should prove too weak, (that is, too thin) it is always possible to make the mold slot wider by removing more steel. This reasoning was very helpful; it made any necessary corrections possible and economical.

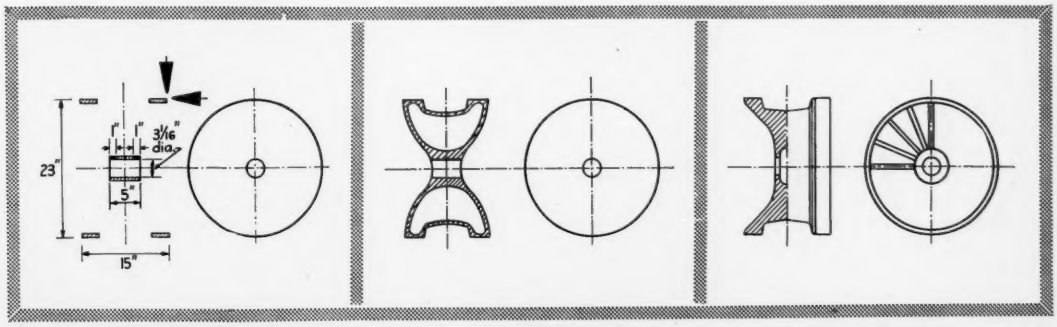
The rim. The rim thickness had two limiting factors. If too thick the weight would have been excessive. (Small differences in thickness make comparatively large differences in weight because of the large circumference). Too thin a rim would be structurally weak. A rough calculation as a simple beam, with the rim thickness as depth, and the distance between two adjacent spokes at the rim as span, gave the present rim thickness for the load of 3,000 lb with a reasonable safety factor.

The back plate. The back plate has three functions:
(1) the stiffening action adds rigidity to the columnar action of the spokes.
(2) provides for easier flow of the premix toward the rim and the periphery of the wheel.
(3) the back plates also have to provide the flat surfaces for adhesive bonding between the two wheel halves. Bosses and recesses were incorporated in the design of the back plates to prevent radial dislocation (slipping, shear).

Stress Calculations

It was not possible to make the stress calculations accurately due to:
(1) lack of reliable design data.
(2) the complex form of the wheel, which made accurate stress analysis impossible.

These two points narrow down conventional design methods to first principles. Stress analysis was used, but only in its broad sense. We tried to "flow the stresses," avoiding sharp corners, using large radii, arranging the geometry of the material mass so that the stress distribution would be as good as possible and choosing the cross-sections that were reasonably within requirements. The choice of cross-sections was a major problem, because they had to be kept down for lightness.



1 2 3

Plastic wheel design continued

All loads are radial; axial loads considered less critical; combined loads assumed not to add.

Rim stresses

Rim was checked as a simple beam with span equal to the distance between two spokes at the rim, with a concentrated load in the middle of 3,000 lb.

span = 4.5 in.
load = 3,000 lb
beam cross-section: b = 3.5in.
d = 0.75 in.

Bending moment = 1,500 x 2.25 = 3,370 in. lb.

$$\text{Section modulus} = \frac{bd^2}{6} = \frac{3.5 \times .75^2}{6} = .327 \text{ in.}^3$$

$$\text{Flexural stress} = \frac{M}{Z} = \frac{3370}{.327} = 10{,}300 \text{ psi}$$

a) Flexural strength of the material used ranged during tests between 7,000 psi and 27,000 psi; for a large majority of samples, over 20,000 psi.
b) The rim had many properties that would classify it as a fixed beam, thus adding to the strength.
c) Part of the load was taken by the back plate.

Spoke stresses

The weakest part of the spoke is a "neck" opposite the end of the internal tire; that is, where the two cones of different angles meet at the "back" of the wheel. Assume the force at the edge of the rim, bending point at the neck. Then cross-section

b = 0.25 in.
d = 2.00 in.
Z = 0.166 in.^{3}
Load = 3000 x cos 45°
= 3000 x .707
= 2120 lb
Moment arm = 3 in.
Bending moment
= 2120 x 3 = 6360 in. lb.

$$\text{Flexural stress} = \frac{M}{Z} = \frac{6360}{0.166} = 38{,}200 \text{ psi}$$

a) This is well over the ultimate flexural stress of 27,000 psi obtained on samples.
b) Rim acts as a stress distributor, never leaving the whole force to act on one spoke only; it distributes the load on several spokes.
c) Back plate helps to resist the bending moment.

Assume that only one paddle (or spoke) resists the bending moment exerted by a force at the edge of the rim, the wheel being supported at the hub.

Cross-section:
b = 0.25 in.
d = 5.00 in.

$$Z = \frac{bd^2}{6} = \frac{0.25 \times 25}{6} = 1.04 \text{ in.}^3$$

Bending moment:
= 3000 x 7.5 = 22,500 in. lb.
Flexural stress due to bending

$$= \frac{M}{Z} = \frac{22{,}500}{1.04} = 21{,}600 \text{ psi}$$

Resulting compressive stress
= 21,600 + 2400 = 24,000 psi
Resulting tensile stress
= 21,600 — 2400 = 19,200 psi

a) There will always be more than one spoke resisting bending.

If one spoke were to carry 3,000 lb as a column, the compressive stress would be

$$f = \frac{P}{A} = \frac{3000}{1.25} = 2400 \text{ psi}$$

P = 3000 lb
A = 5 x 0.25 = 1.25 in.^{2}

This appears to be quite reasonable, especially when the back plate carries part of the load.

Hub stresses

The entire wheel at the hub is supported by two projected areas.

A = 3.062 x 1.00 = 3.062 in.^{2}

The compressive stress on the hub, with a 3,000-lb load acting at the edge of the rim, is:

$$f = \frac{3000}{2 \times 3.062} \pm \text{stress due to bending moment}$$

The bending moment was resisted by a couple formed by the two hub areas

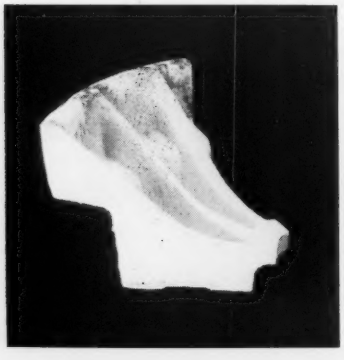
22,500 in. lb = P x 4

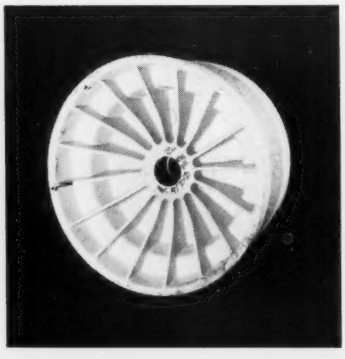
$$P = \frac{22{,}500}{4} = 5620 \text{ lb.}$$

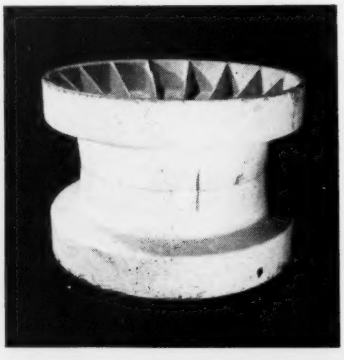
Compressive stress

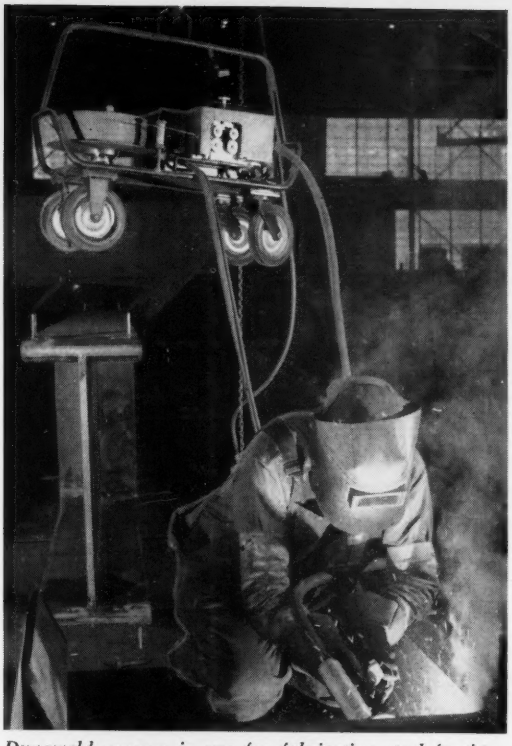
$$f_1 = \frac{3000}{2 \times 3.062} - \frac{5620}{3.062} = -1340 \text{ psi}$$

This means that the opposite side of the hub is compressed.



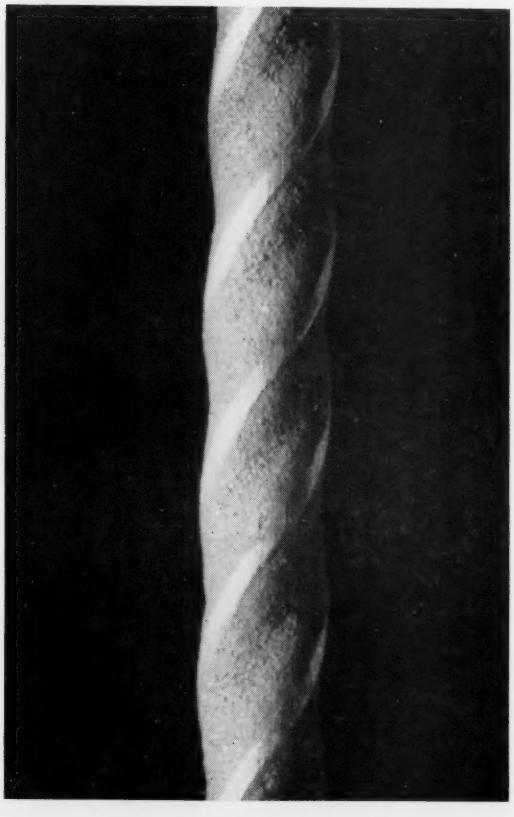






Dynaweld process in use for fabricating steel footings.

Closeup of a ¾ in. length of the new twisted filler wire.



Endless electrode in welding system cuts waste, time

Just announced by Canadian Liquid Air Company Limited: a continuous-arc, mild steel welding system, as simple to use as stick electrodes, but without the disadvantages of low-duty cycle, stub waste and so on.

Designed and developed by their research and engineering teams, the new process has had more than a year of exhaustive field tests under practical conditions in several major industries in Canada. It will be known as the *Dynaweld system.*

Amongst its advantages is the substantial increase in productivity when the process is used on suitable applications. This results from the high duty cycle, the higher-than-usual current rates used and the resulting greater deposition of weld metal. Simple to use, the Dynaweld system is *completely independent* of water cooling or gas shielding.

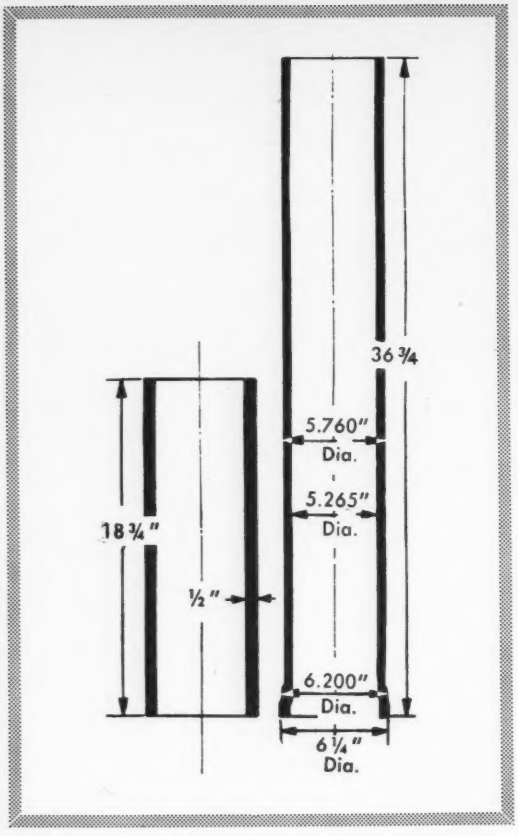
The heart of the Dynaweld system is a precision-twisted, coated filler wire which is essentially a "continuous" coated mild steel stick-electrode. The wire is drawn off its power-driven supply reel at predetermined speeds through associated equipment and fed through a specially designed pistol-type electrode holder. Welding current is supplied from any standard ac or dc welder (preferably the latter).

It is simple

No complex mechanical or electronic apparatus is necessary; nor is any auxiliary apparatus (other than the source of welding current) required in its operation. The system uses a compact, extremely portable machine having a specially designed mechanism for the control and delivery of the electrode to the work at a predetermined speed. The ruggedly built machine has few moving parts and maintenance is negligible; it is mounted on rubber-tired wheels for easy movement and is equipped with a hoisting frame.

The Dynaweld system is highly recommended for production mild steel welding operations, where at the moment large quantities of conventional or iron powder stick electrodes are being used. Metallurgically, weld deposits from Dynaweld wire are comparable in every way with those from standard mild steel electrodes in the AWS E 6012, E6024 and E 6020 classifications.

Part of Liquid Air's service includes an offer to make practical, on-the-spot studies of plant welding applications, to determine the suitability of Dynaweld. ★



Medium diameter straight wall tube cold extruded from hot rolled MS tubing. Original wall ½ in. thick reduced to ¼ in. wall thickness within tolerances OD +0.010 in. to —0.005 in. and ID + 0.003 in. to —0.003 in. Blank length 18¾ in. spun length 36¾ in.

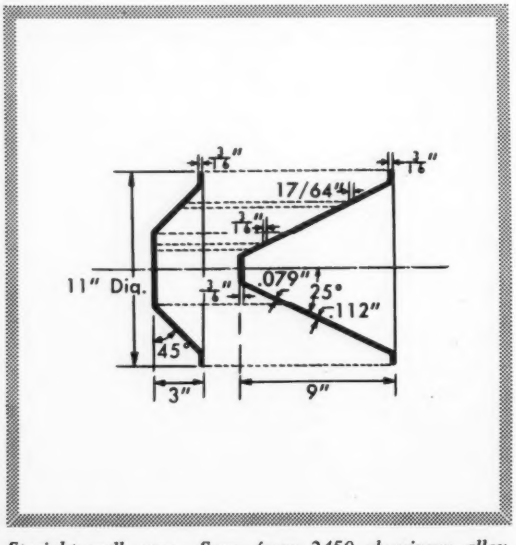
New shapes from hard-to-work alloys

Rotoforming is an automatic process in which ductile metals (usually cold) are precision formed into hollow conical, spherical or cylindrical shapes by actual displacement of the metal under high pressure. Conical or spherical parts can be formed having diameters up to 42 in. and lengths up to 50 in. Cylindrical shapes can be formed in lengths up to 100 in.

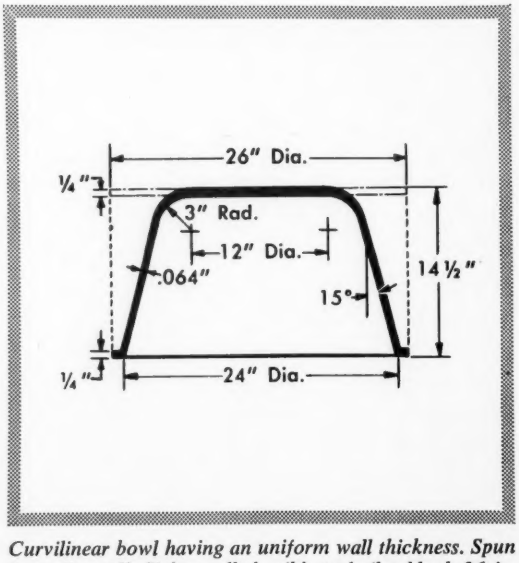
The Commercial Shearing and Stamping Co. is one of the first metal fabricators in the world to install these machines, made by Cincinnati Milling Machine Company, who refer to the process as Hydrospinning. Commercial engineers have been exploring and developing new applications of the process.

The process: A simple metal blank or preform made from mill-rolled sheet, plate or tubular stock, forgings or castings is mounted on a rotating mandrel which has the shape desired of the finished piece. The blank is subjected to very accurately controlled spinning movements by rollers which traverse the mandrel, forcing the metal against it, literally squeezing and stretching the blank into shape.

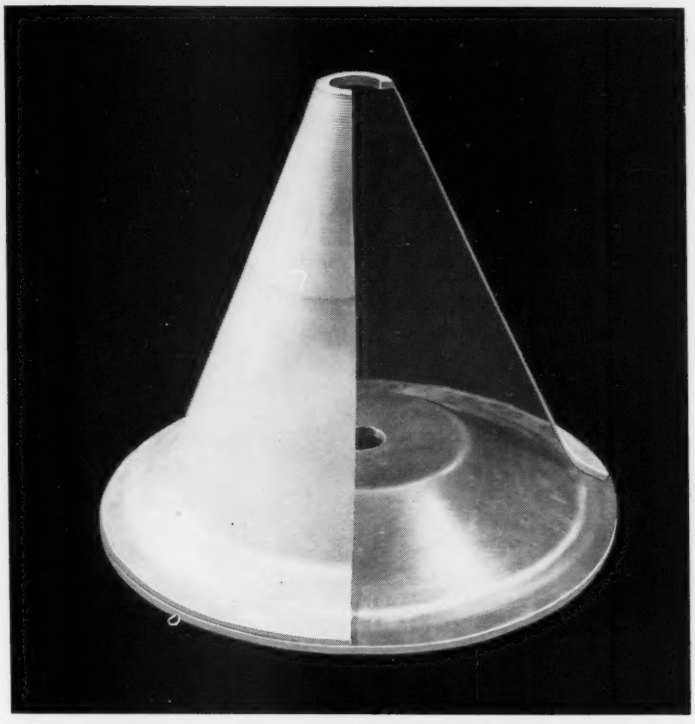
A wide variety of annealed low carbon steels, stainless and special steel alloys and aluminum alloys, have

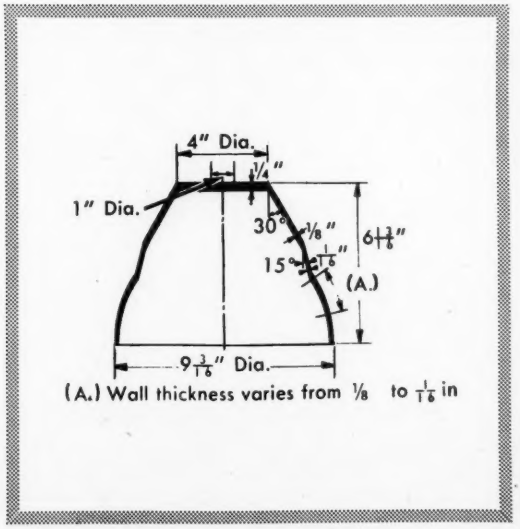


Straight wall cone. Spun from 2450 aluminum alloy, 3/16 in. thick from preformed disc (left) of 11 in. dia. Included angle 50 deg. Wall thickness: varying. Straight wall cones like this can be spun from flat blank and result in an uniform wall thickness.



Curvilinear bowl having an uniform wall thickness. Spun from "as rolled" hot rolled mild steel, flat blank 26 in. dia., ¼ in. thick. Included angle 30 deg. or approximately 75% reduction of blank, 30 deg. is the smallest included angle now considered practical.





Curvilinear cup with irregular varying wall section. Spun from type 302 stainless, flat blank 12¼ in. dia., ¼ in. thick. Spun to "Sine law," i.e. thickness of finished wall equals thickness of blank × the sine of ½ the included angle.

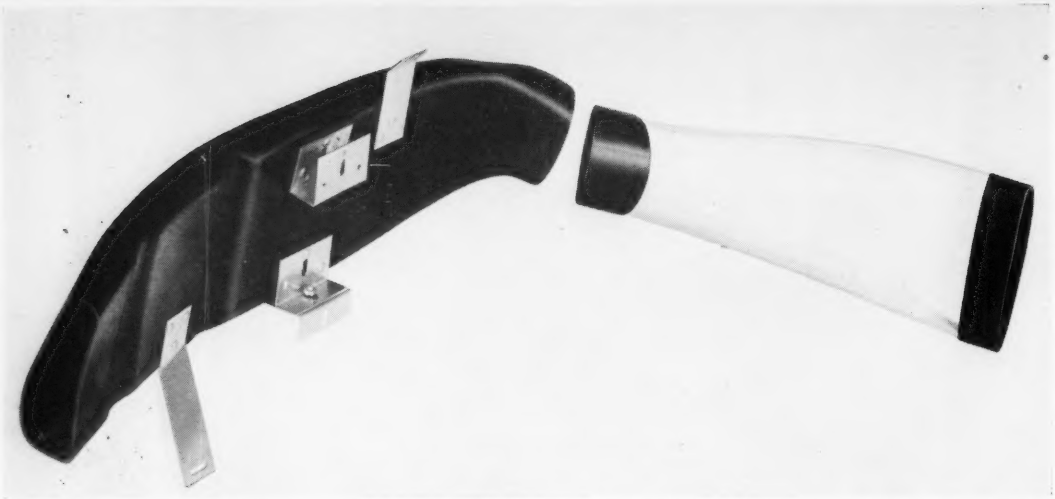
so far been successfully Rotoformed. Other metals (nickel, cobalt, molybdenum, titanium and magnesium alloys and cast copper) have been experimentally formed by this still very new method.

The complete answer to the range of shapes is still being sought by Commercial engineers. Basically, the shapes fall into four main categories: conical, curvilinear, elliptical and cylindrical. There are many variations possible as to wall thickness, which can be constant or variable. Pieces can be straight-walled, curve-walled or tapered. A few of the many applications within these basic categories are shown.

The metal actually undergoes plastic deformation and the grain structure of the metal is greatly elongated. The result is a substantial increase in tensile strength, yield strength and resistance to fatigue.

How does the process help the design engineer? The process makes it possible to produce shapes previously considered impractical or shapes from hard-to-work alloys not before attempted. The design engineer therefore has a much greater choice of materials.

Because metal parts formed by the method gain increased strength, hardness and fatigue resistance, it is often possible to substitute cheaper materials for alloyed stock. Expensive machining, swaging, drawing and bulging operations are eliminated. There is minimum of waste metal. All these facts point to better performance and decreased costs. ★



1. Like the item shown in fig. 2, these are parts of the ducting for an air conditioning system for an automobile.

Blow forming

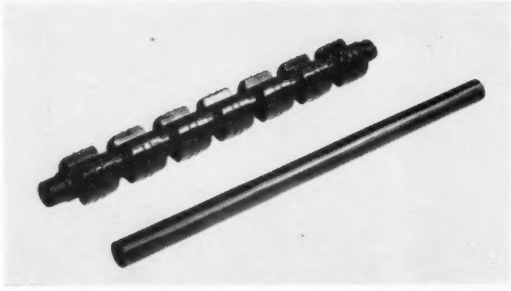
The use of blow forming for making highly contoured hollow forms that are difficult (or impossible) to make by other methods, results in practical, cheap products, held to close tolerances and precise dimensions. The method is well suited to large pieces beyond the capacity of some injection or compression molding machines for large or small runs, with low tooling cost. Practically any thermoplastic material can be processed. The method adopted by L. A. Darling Company is as follows:

The tube Fig. 3(a) from which the component is to be made is first placed in an electric, air-circulated oven to bring it up to blowing temperature. The tube is on rollers, and revolved during its heat cycle in circulated air at 300 to 350 F. Heating time depends on the type of material (butyrate, acrylic or hi-impact styrene) and the wall thickness of the tube being used.

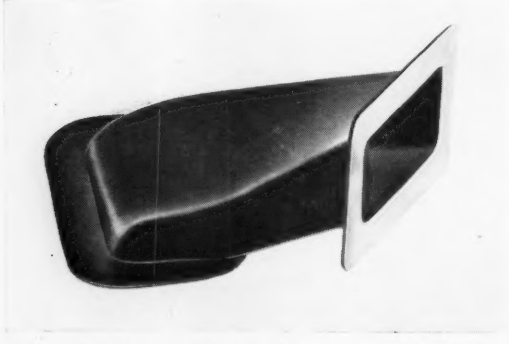
After heating to a uniform temperature, the tube is ready to be blow formed. A solid plug is placed in one end of the tube, and a plug connected to an air hose in the other end. The tube is then moved to a forming mold.

The press is closed and the upper half of the mold comes down over the tube and seals it on the two plugs. Air pressure is applied and enters the trapped tube at a pressure of 15 to 50 psi. The pressure depends on the type of material being used. The tube expands under pressure and fills the cavity of the mold.

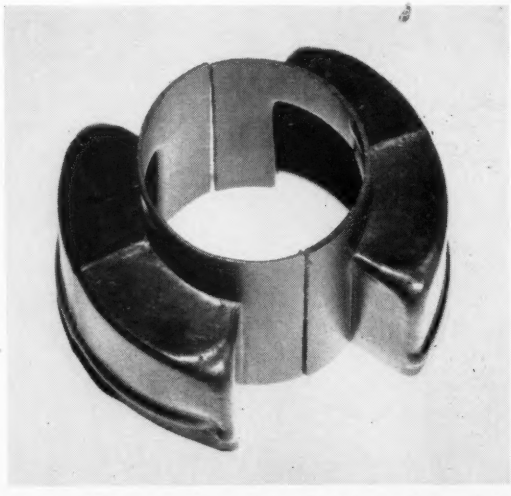
After the tube has been blown to the shape of the mold, cold water is flooded through both upper and lower cavities of the mold until the plastic material has set to the shape of the mold. The air line is then disconnected, the press opened and the part removed. ★



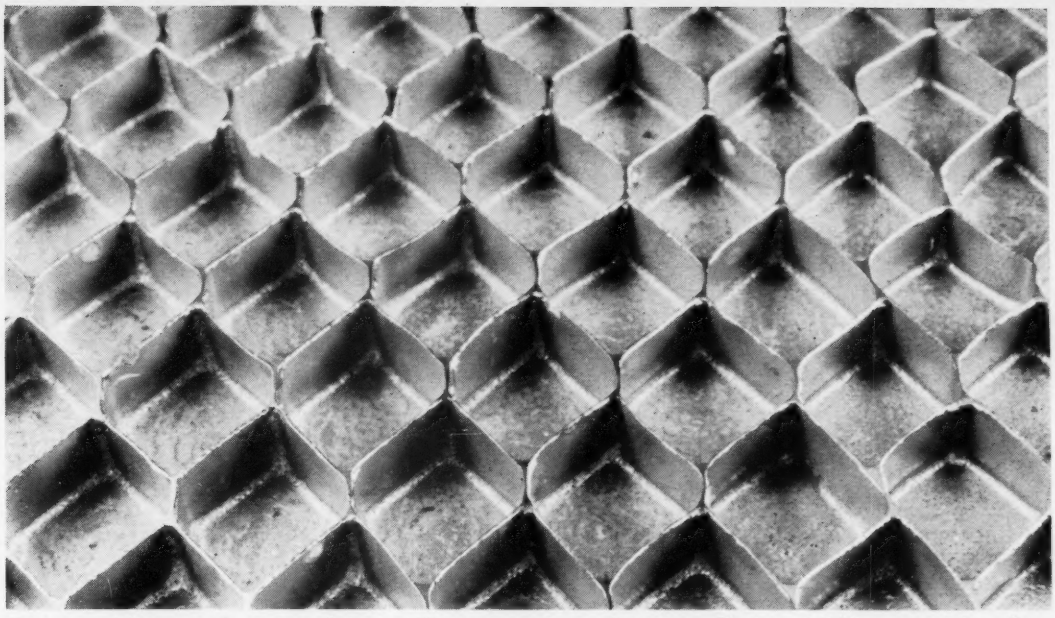
3a (below) & 3b (top). Tube before and after molding.



Automobile air conditioning duct of modified Styrene.



4. The blown part is cut to make 14 switch brackets.



Cutaway of honeycomb section shows excellent penetration and uniform filleting of lithium containing alloys.

These filler materials stand the heat

Here's what the search for heat-resistant filler materials brought to light

The increasing service temperature requirements imposed on brazed assemblies for a growing variety of industrial equipment has focused attention on newer types of filler metals to make dependable joints in heat-resistant alloys on a production basis. Table 1 lists some of the brazing filler metals that are showing the greatest promise for these high-temperature requirements.

(1) **Silver-base lithium alloys:** Recent research performed at the Armour Research Foundation (under the sponsorship of the Lithium Corporation of America) shows that lithium makes an important contribution in filler metals for brazing heat-resistant alloys. This research (now confirmed by industry experience) shows that a small addition of lithium markedly improves the fluidity and wetting ability of many standard alloys. Thanks to the lithium modification, it is now possible to braze stainless steeel in an atmosphere (without flux) at temperatures as low as 1600 F.

The lithium alloys typically contain 0.2% lithium. One such filler metal (sterling silver with lithium) is rapidly gaining favor for brazing honeycomb panels made up of17-7 PH stainless steel. Its flow temperature corresponds to the temperature for proper heat treatment of this metal, and the joints retain a tensile strength of about 35,000-40,000 psi at 900 F (short-time test), which is the maximum service temperature for 17-7. Furthermore, the filler metal readily wets in vacuum, dry hydrogen or inert gases, without flux.

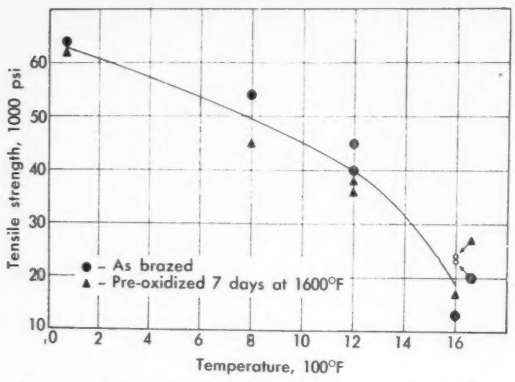
Excerpts of an address by A. M. Setapen (Manager of Engineering, Handy & Harman, New York) delivered at the Midwest Welding Conference, sponsored by the Armour Research Foundation, Chicago, Illinois.

Because of its high fluidity, this silver-copper-lithium filler is most suitable for penetrating small gaps between the components of the brazed sandwich, and it represents a marked improvement over silver-manganese, which does not easily wet 17-7 PH steel. Joints of sterling-lithium alloy are more corrosion resistant than those of silver-manganese. It is reported that the use of this lithium alloy (in place of silver-manganese) has reduced the reject rate on brazed honeycomb sections from 45-50% to less than 10%. The high fluidity of the alloy has, however, been found objectionable on large, curved surfaces, because of excessive run-off of the molten alloy. New developments are currently under way to overcome this problem. If successful, they should improve the process of brazing honeycomb panels and may reduce costs to the extent that brazed honeycomb will become a standard high-strength, light-weight structural material.

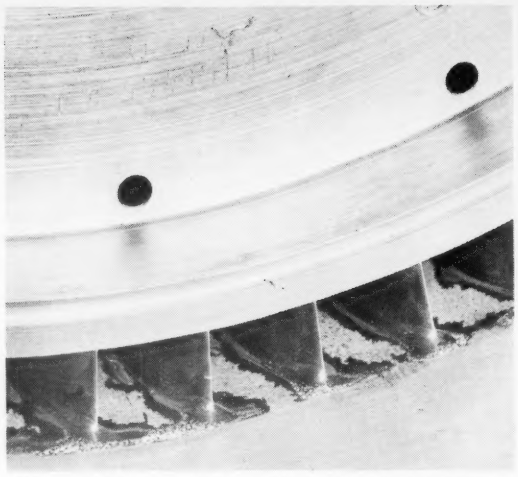
Other fillers (to which the addition of small amounts of lithium has proved advantageous) are the silver-copper eutectic (AME 4772) and silver-manganese (85-15). These materials are being used for brazing stainless steel bellows, instrument assemblies, hydraulic lines and various jet engine parts.

Another development is the silver-lithium binary, containing 2-3% lithium. This alloy has shown promise for brazing titanium and its alloys. Peel strength is not yet satisfactory for some applications, but work is under way to improve this property.

(2) **Silver - palladium and silver - palladium - manganese.** These alloys have been used to some extent in the U. K. and are of some experimental interest here. Palladium additions to silver increase the melting tem-



The strength of gold-chrome-nickel joints in stainless.



4130 molybdenum steel assembly. 2100 deg. F. furnace.

perature, the strength and the ability to wet iron- and nickel-base alloys. Manganese further improves the wetting. The alloys do not penetrate or dissolve the base metal to any extent. Joints of these alloys have been reported as less susceptible to crevice corrosion attack than those made with silver-manganese alloys. Their resistance to oxidation is like that of silver-base alloys.

(3) **Manganese-nickel.** 70%-30% manganese-nickel is being used very successfully for joining stainless steel, inconel and other heat-resistant alloys. At elevated temperature it retains much of its high joint strength (55,000-65,000 psi at room temperature) and offers better oxidation resistance than either silver-copper-lithium or silver-manganese. Its properties fall midway between the two latter fillers and the nickel-chromium-silicon-boron filler metals. That is, in oxidation resistance, it is better than the high-silver fillers, but not as good as the Ni-Cr-Si-B group. On the other hand, it has much less tendency to dissolve or penetrate the base metal (highly undesirable with thin sections) than the high-nickel alloys. Preliminary tests with manganese-nickel have yielded excellent results, and the material is now being actively considered for brazing heat exchangers, rocket motor parts, clad metals and turbine blades. It is available either in powder or in thin strip.

(4) **Nickel-silicon-boron and nickel-chromium-silicon-boron.** This group of alloys contains nickel as the main constituent, with silicon and boron as the other alloying elements. In addition, in two of the alloys (including AMS 4775) part of the nickel is replaced by chromium to provide superior oxidation and corrosion resistance. In hardness and strength retention over the 1600-1800 F range, these high-nickel materials are unsurpassed. However, they do attack many base metals by intergranular penetration and solution.

Typical applications include: a vane-and-shroud assembly of 4130 chrome-molybdenum steel brazed at 2100 F; a nozzle assembly of Hastelloy-25 and type 304 stainless steel brazed at 2150 F; and a flat tubular stainless steel heat exchanger brazed at 1925 F.

(5) **Gold alloys.** In situations where intergranular penetration of the base metal cannot be tolerated (and where high strength and excellent oxidation resistance are required at temperatures around 1600 F) there is a strong interest in gold alloys. To be sure, the high gold content makes these alloys expensive on a per-ounce basis, but in most cases the value of the assembly (and the extreme importance of reliable high-temperature performance) outweigh, by far, the cost of the small amount of alloy needed to make the joint. Compared with the high-nickel alloys, the gold alloys have lower hardness, better ductility and less intergranular penetration. ★

Table 1. Some of the newer filler metals for brazing heat-resistant alloys.

	Percentage composition											
Alloy type	**Ag**	**Au**	**Pd**	**Cr**	**Mn**	**Cu**	**Ni**	**Li**	**Si**	**B**	**Melt (deg F)**	**Flow (deg F)**
Silver-copper-lithium	92.3					7.5		0.2			1435	1635
Silver-palladium	90.0		10.0								1835	1950
Manganese-nickel					70.0		30.0				1840	1875
Nickel-chromium-silicon-boron	(Balance Fe)			16.0			72.5		5.0	3.5	1825	1840
Gold-chromium-nickel		72.0		6.0			22.0				1785	1835

1a

1b

1c

Case history lessons in spring design

A series of nine case histories points up the need for taking a good look at the design of any springs you plan to use in your products

Springs (and components with a spring-like action) are frequently the "heart" of a product, even though their cost may represent only a small fraction of the product's total cost. The design of these vital elements consequently deserves the attention of the best-qualified engineers.

Because spring design can be a complex matter, it is generally better (once the fundamental performance requirements have been determined) for the product designer to share the design duty with a competent and thoroughly experienced spring engineer. This assistance frequently leads to the design of a component that meets all the requirements more efficiently, sometimes with less volume of material, and often at less cost than the original concept of the product designer.

Actual case histories from the files of Associated Spring Corporation (a leading manufacturer of precision mechanical springs) are given in this article. They show how early consultation pays off.

Thousands of similar examples could be given to show how time and money have been saved (and better performance obtained) by early consultation between the product designer and an experienced spring engineer.★

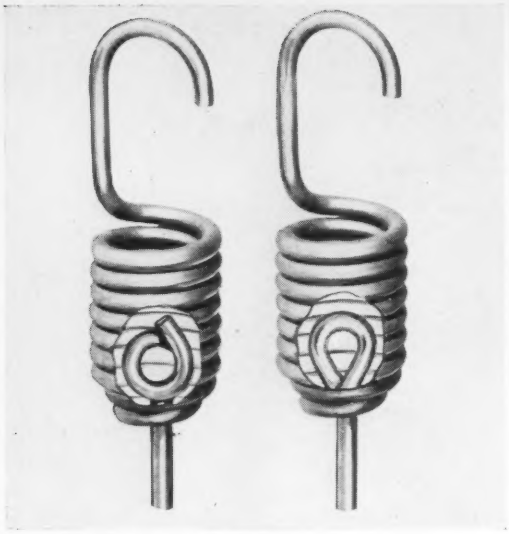
Case history 1. *Three springs for an automatic washing machine:*

Vibration-control and motor-speed regulation were two of the major considerations.

To function properly, the spinner must agitate both vertically and laterally. This vibration must therefore be in two directions. The product designer decided that damping of the horizontal vibrations was best accomplished by a flat spring, and set the specifications for its shape and size. Vertical vibration presents a problem involving space and the proper method of attaching the springs to the frame. The design called for help here.

Also, the drive motor must be protected from overload at varying speeds. The designer conceived a safety clutch spring that presented the tricky problem of providing high strength with sufficient torsional action to compensate for the uneven rate of operation. He laid down limits for the springmaker to work within.

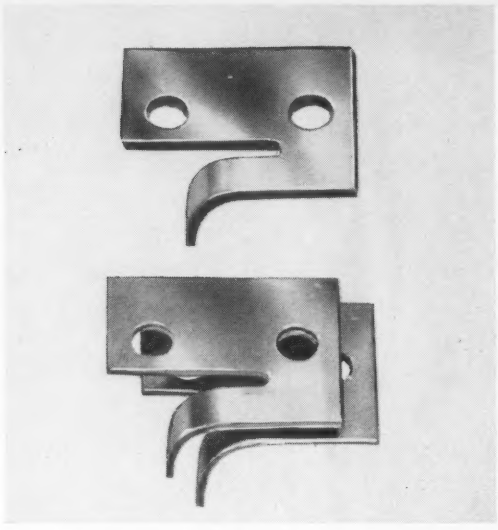
A sales engineer was then called in. He checked the flat spring designed to control the horizontal vibration Fig 1 (a) and recommended a specific Wallace Barnes spring steel with the desired long-lasting resiliency, cadmium-plated for corrosion resistance. To handle the vertical damping action, he designed a barrel-shaped spring [Fig 1(b)] with offset ends, to eliminate the problem of end-fracture due to stress concentration.



Case history 2. *A brake return spring.*

A connecting link inserted in one end of the spring had a sharp end that rubbed on the coils in the tapered end of the spring, causing wear and excessive breakage.

Modification: the loop in the connecting link was redesigned with an additional half turn. This completely eliminated breakage.



Case history 4. *A stop spring.*

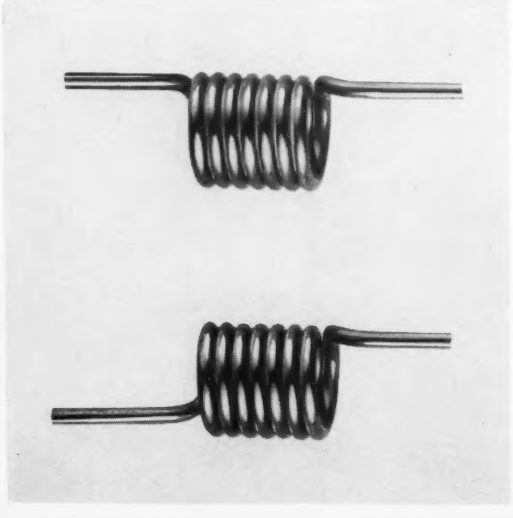
In the original design, the spring (formed of 3/64 in. material) suffered from excessive breakage.

Modification: Associated Spring recommended the use of a pair of springs, each made of thinner stock, to obtain the same unit load and deflection with reduced stresses. This licked the breakage problem.

Case history 3. *An air-valve torsion spring.*

The original design presented a serious breakage problem.

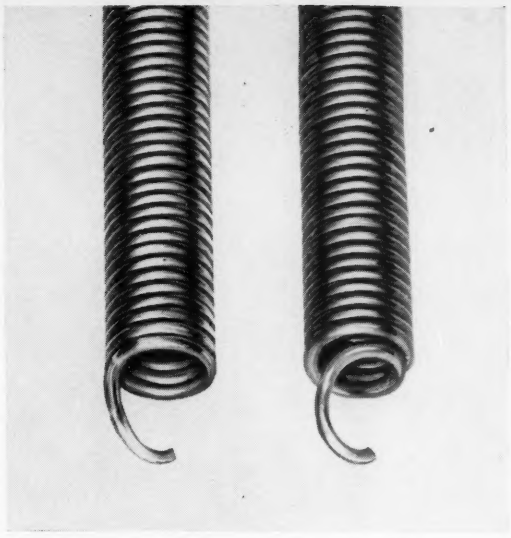
Modification: after consultation, the spring was redesigned to use a slightly larger wire, with a larger radius for the offset bend, and called for a more generous-sized hole in the valve-body for the insertion of the ends. Fatigue tests proved the new design to be far more satisfactory. The new design is the lower of the two.



Case history 5. *Lever for a jet engine.*

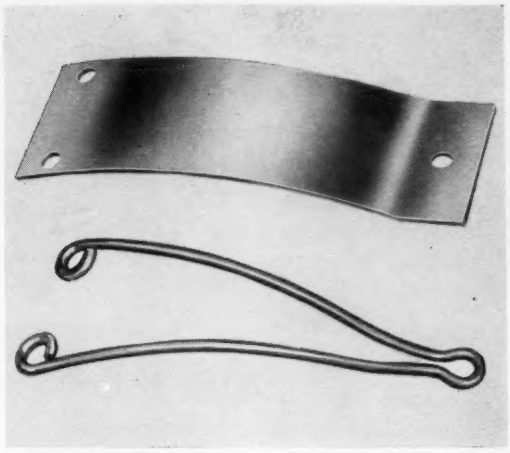
The original design would have entailed costly machining or forging.

Modification: engineers recommended a new design, using a standard ball-joint-bearing press-fitted into one end, and a spacer on the other. New design can be stamped, thus eliminating machining and brazing. The new design is the lower of the two.



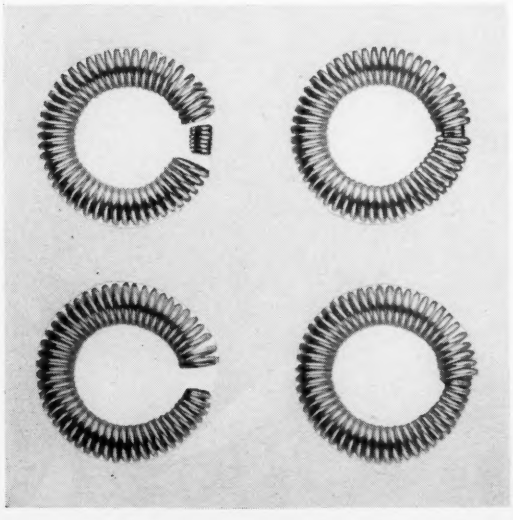
Case history 6. *A door-return spring for a range.*
The original design did not have sufficient fatigue-resistance, due to stress concentration in the hook-ends.

Modification: redesign reduced the size of the end coils, thereby lowering the stress in this area of the spring and eliminating the hook-breakage.



Case history 8. *A snubber spring for an automatic washer.*
In the original design, the flat spring used for this purpose did not provide the versatility in assembly that was offered by the wire-form that replaced it. Considerable savings in material and manufacturing cost were also achieved.

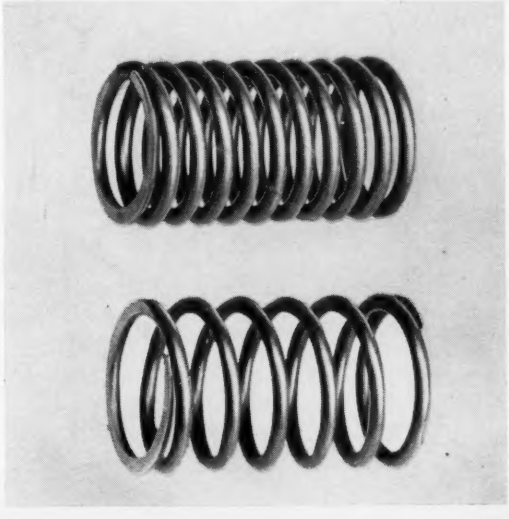
Case history 7. *A retaining spring for a circuit-breaker.*
In the original design, an extension spring was formed into a complete-circle "garter" spring by inserting a smaller coil spring into the two ends as a kind of screw-plug. Assembly cost was high and the operation was difficult.
Modification: redesign eliminated the small plug-spring, joined the two ends by reducing the diameter of one end slightly, so that it could be inserted into the other end. Assembly was considerably speeded up, and the joint case was actually stronger than before.



Case history 9. *A refrigerator spring.*
The original design, with 11 coils of 0.120 in. diameter wire, proved to be understressed.

Modification: redesign called for the use of 0.105 in. wire, and only 7 coils.

This provided ample stress-carrying capacity and resulted in substantial savings in both material and manufacturing costs.



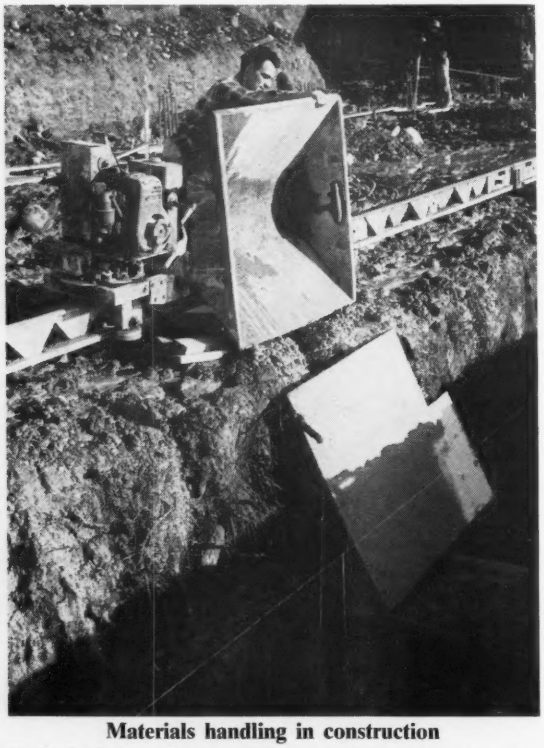
Design news in pictures

Insulation fitted faster

Designed to cut down labor time, these glass fibre insulation pieces for piping are molded in matching halves. A junction can be insulated in moments and the molded parts are shape-retaining for the life of the insulation. (200)

Functional look in weightlifters

Showing off for the camera, a yard crane and lift truck flex their muscles. Engineering merits aside, the units give off excellent first impressions by the use of clean, design-conscious profiles. (201)



Materials handling in construction

Brainchild of a British engineer is this monorail system of on-site materials handling. Powered by a 6 hp gasoline engine, the wagons are controlled with a single lever and driven by double-flanged wheels atop the steel rail. (202)

Styling for a motorbike

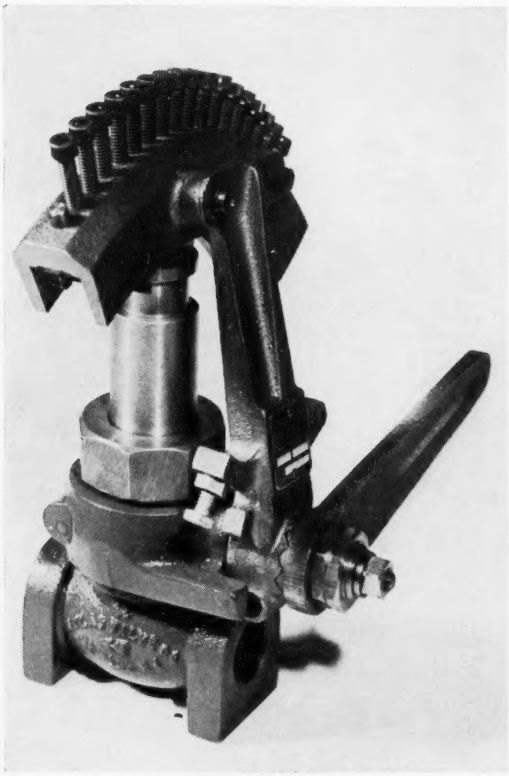
Decidedly European in design, this smoothly-flowing scooter style motorbike hails from the Netherlands. Following a trend set by some small European autos, this bike is frameless and a gasoline saver. (203)

Extrusions for a revolver

Production of swing-out arms for the cylinders of a popular 9-shot target revolver has been simplified and speeded up to six times the former production rate by using hot extruded-cold drawn steel. (204)

British comfort

With an 18 hr. burning time at full flame, this paraffin oil heater comes, as one might expect, from England. It is made of sheet steel with a grey and black stove enamel finish, bright aluminum reflector. (210)



Mix and meter

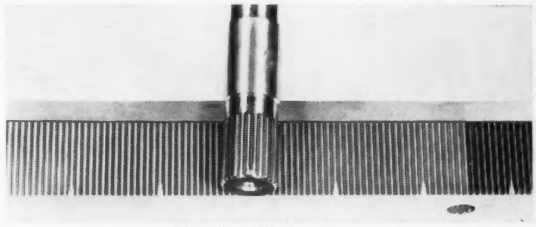
This is an adjustable cam, lever operated valve for metering fuel oil. The valve will control and maintain a certain flow ratio between two variables (such as air and oil) into an oil fired steam boiler. (205)

Panel for your patio

This structural plastic panel has an inner layer of perforated and embossed aluminum foil which acts as a heat barrier. The sheet passes diffused light through the perforations and screens about 80% of the heat from the sun. (206)

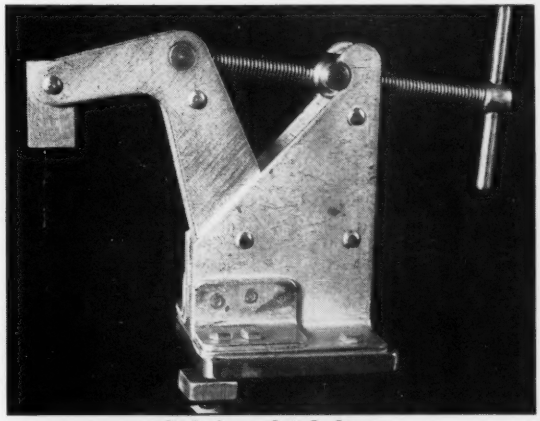
Aluminum dump body

Use of aluminum has cut weight of this dumper body by over 10%. The body has a bolted (rather than welded) construction in order to simplify field repair problems and is basically constructed of U-shaped extruded planks. (207)



Teeth without tears

Splined parts are often needed with one or more teeth wider than normal to ensure correct index alignment. These teeth are produced by grinding off the teeth in the forming rack which would produce the spaces at the locating point. (208)

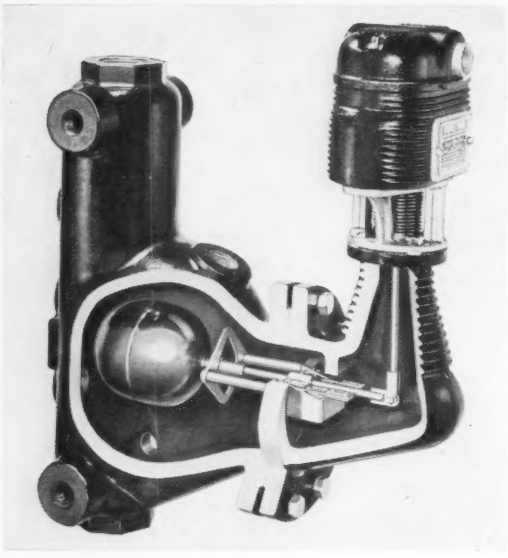


Cadmium plated clamp

Cadmium plated, this 6 in. high tensile steel fixture clamp is designed for heavy-duty applications. These new clamps are currently in production and can be purchased with base plates and T-bolts for quick machining applications. (209)

Ideas round-up

Safety valve: it may only work once but work it must



Operating engineers know the importance of accurate, dependable controls to ensure smooth uninterrupted operation. As pressures and temperatures go up, the need for better safety controls becomes more essential.

To meet this need for an advanced type of control, McDonnell & Miller overcame two problems.

The first step required the magnetic mechanism of the safety device to use an alloy with high magnetic strength and retentivity, and having positive reaction when the float passes a set level.

Alnico V nickel-aluminum-cobalt-iron alloy was the answer. These permanet magnets, used on the contact arms of each magnetic switch, provide all the desired properties, with less weight, space and cost.

The second problem (the float) was one solved twenty years before. Here was needed a corrosion-resistant alloy that combined the necessary strength with a high collapsing pressure, as well as ductility for forming the halves of the sphere. Monel nickel-copper alloy has proved itself to be the best possible selection for this application.

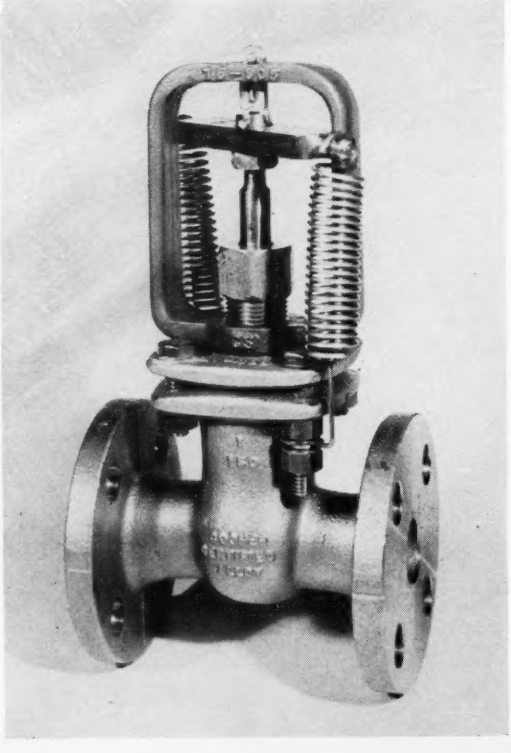
Like a parachute, a boiler safety device may be called on to operate but once: when the call comes, however, only the best is good enough. (212)

Gate valve: it shuts off flow when a fire starts

The Valve and Fitting Division of Cooper Alloy Corporation has just announced a stainless steel fire protection, spring-loaded gate valve.

Many plant fires start in one location and then spread out of control when fed by process piping carrying additional combustibles to the area. This particular valve is a safeguard against fire feeding, for it is designed to shut off fluid flow as temperatures build up. Manufactured with petroleum producers, acid plants, pharmaceutical firms, film processors and liquid combustible producers in mind, the valve features a special bonnet equipped with a fusible link. The valve closes when the temperature reaches the link melting point of 160F, separating the link, which releases the springs and shuts off the supply of combustibles through the valve into the fire area.

Also designed into the valve is a rotating double disc assembly that maintains a tight seal, even if the body distorts due to heat. With springs made of stainless steel to resist atmospheric corrosion during normal plant operation, the valve is available in alloy types 304, 316, FA-20, as well as monel and nickel in sizes from ½ to 2 in. A retained bonnet gasket for higher, more uniform loading and one-piece stem and disc carrier is also incorporated. Operating pressures are up to 150 psi. (213)



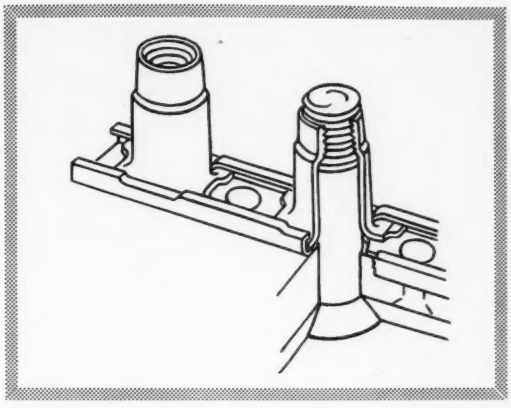
Anchor nuts: designed for aircraft components

Self-locking, floating anchor nuts with a deep counterbore, have been developed by the Elastic Stop Nut Corporation of America. They are designed to speed production and reduce the weight of airframe and aircraft components, where members of varying thicknesses have to be joined.

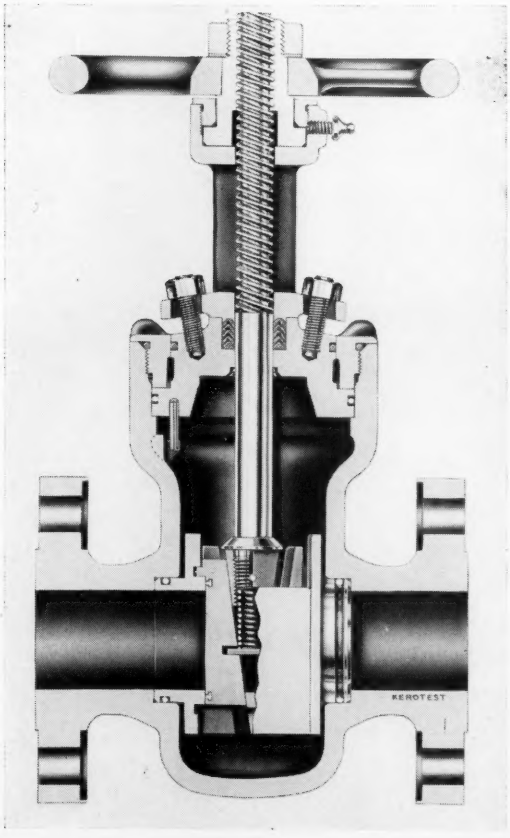
Lighter than many present floating anchor nuts, the deep counterbore design also saves weight by eliminating the multiple shims that would otherwise be required. Typical assemblies are shown. On the assembly line, important time-and-labor saving also results from this avoidance of the slow, possibly inaccurate, hand-selection of multiple shims and correct-length bolts.

Types in the new line are a two lug anchor nut (LHA3006), a one-lug anchor nut (LHA3207) and gang channel assembly (G15). Designed for service at temperatures up to 550F, the parts meet tensile, twist-out and push-out requirements of AN-N-10 and MIL-N-25027 (ASG).

Types LHA3006 and LHA3207 are designed in thread sizes 10-32, ¼-28 and 5/16-24. Straight gang channel configuration, because of the differing nut spacing and counterbore depths required, can be made to order. (214)



New valve design: two years of field tests



After more than two years of rigid laboratory and field tests, Kerotest Manufacturing Company have put into production a completely new concept in valve design. This is the Keroseal, a non-lubricated, optional-flow, double block and bleed full opening valve.

It is designed to handle gases, petroleum products, petrochemical fluids and many other products.

The valve features: a new principle of operation that completely eliminates galling or wear at the seating surfaces; insurance against product contamination through a vapor tight seal; design which permits servicing without having to remove the valve from the line; minimum maintenance.

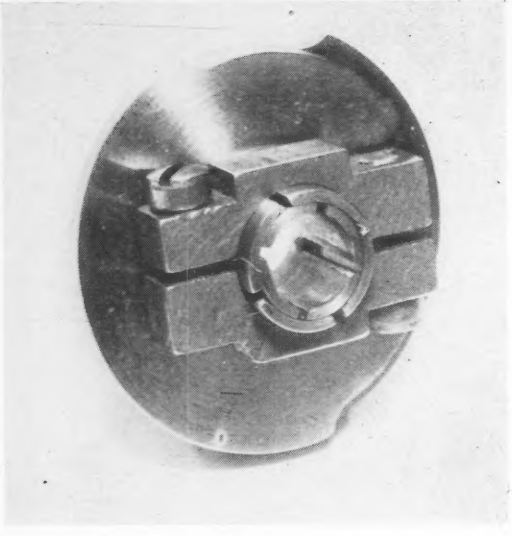
Provision has also been made for the installation of a bleed valve, a positive check on the efficiency of the seal. Sticking, friction, chatter and wiping action across the sealing surfaces have been eliminated.

Driven either by handwheel, gear or motor, the valve is operated by the raising and lowering of the threaded stem. In opening the valve, the counter-clockwise turning of the hand-wheel first withdraws both upstream and downstream disc from contact with the seat rings in the body, before raising them out of position, thereby eliminating drag during the opening operation.

In closing, the discs are held away from the floating seat rings until the final point of closure is reached, at which time a wedge type spreader forces the discs against the seat rings. Teflon inserts in the discs form a vapor tight seal.

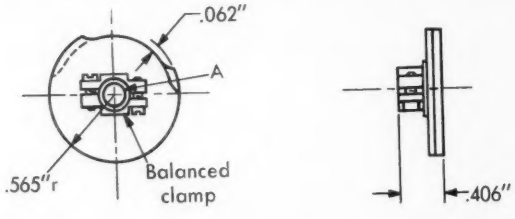
An effective new method of guiding the seat disc assembly, completely independent of the valve body, maintains clearance between discs and seat rings during operation. This feature safeguards against wear, frictional drag wiping and consequent galling of the sealing surfaces. (215)

Adjustable cam: for use in servomechanisms



Model T-159 is an adjustable cam assembly designed by Sterling Precision Corporation for use in servo mechanisms where it is desired to actuate switches (and similar devices) at predetermined angular limits.

Two stainless steel cams may be rotated relative to one another to permit adjustment between rises from 0 to 180 deg. A balanced clamp secures the assembly to the shaft, as well as locking the cams for the desired setting. Maximum diameter is 1⅛ in. and hubs are available for ⅛, 3/16 and ¼ in. shafts. (216)



Model No.	Dash No. shaft diameter	Dimension A (in.)
T159	—2 (⅛)	.1252 / .1254
	—3 (3/16)	.1877 / .1879
	—4 (¼)	.2502 / .2504

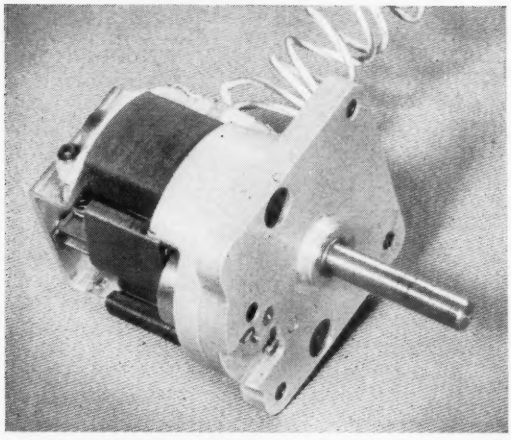
Boring machine: two spindles in a single body

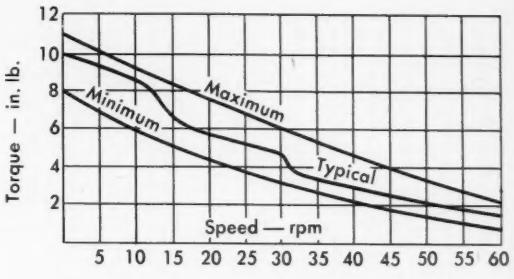
Equipped with two spindles in a single body, but running independently of (and eccentrically to) each other, a Style 112-D precision boring machine is holding close tolerances with a good finish on cast-iron oil pump bodies for automatic transmissions, reports Ex-Cell-O Corporation. An outstanding feature of the unit is the inclusion of special tool setting gauges that permit quick, accurate tool changing and increased production.

Positioned on a foolproof pin, the part is located peripherally from its O D and by a radial locating pin. A hydraulically operated fixture jack backs up the part during the machine cycle. Using two independently operating boring spindles (one turning within and eccentric to the other) the part is bored and turned to produce concentric and eccentric diameters, and plunge-faced in two pockets. Specifically, the outer spindle (equipped with a special cutter-head carrying two tools) bores and turns two concentric diameters and plunge-faces one pocket surface. The inner spindle (also carrying two tools) bores an arc and a bushed hole eccentric with the outer surfaces. At the end of the boring stroke, another pocket surface is plunge-faced and blended with the plane of the first. Eccentricity of the machine diameters is held to .300 ± .0005 in. Pocket faces are held square with the diameters to .0005 in. per in. of run-out. Net production rate is 51 pieces per hr. (217)

Actuator motor: a new type of clutch

The Viking Tool and Machine Corp. actuator motor is a true rotary solenoid with a dynamically stable armature vibrating at 120 cps when operating from a 60 cycle power source. The vibratory motion consists of a power drive stroke and a return stroke. Energy from the power drive stroke is used primarily for output torque. A small portion is, however, stored in a pair of balanced springs and used for the return stroke of the armature. This full cycle takes place within each half of an ac cycle. Output torque is transmitted from the armature during the power drive stroke through a novel, rapid-action, one-way clutch to the output shaft. The





Curves are based on 115 volts ac and 400 milliamps

motion at the output shaft is (theoretically) a very rapid start-stop pulse output. Actually, under very light loads, the inertia of the clutch and output shaft is sufficient to cause practically uniform rotary motion. Under heavy loads (or with the addition of detenting action) the motion will be of a stepping type, wherein the full torque is delivered and complete stopping obtained within each half of an ac cycle. Because of the start-stop motion, the starting torque and the running torque of the motor are equal.

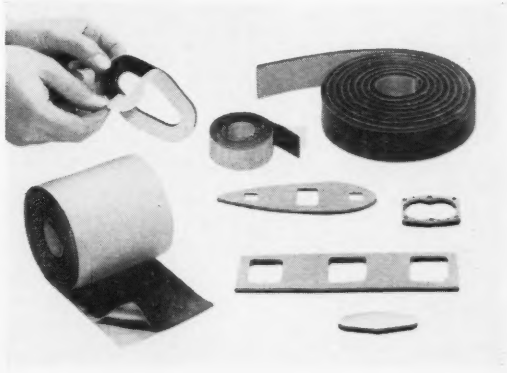
This actuator motor is suited for the following applications: rotary selector for wafer, coaxial or other types of switches; remote control switching and homing devices; valve operation; venting and coin operated machines of all types; electric counters; power stepping switches and indexing devices of all types. (218)

Adhesive backings: a wet and a dry type

Two types of adhesive backing are used on rubber and synthetic parts made by the Mechanical Rubber Products Company. In the "wet" type, the pre-cemented surface is covered with holland cloth, and the operator needs only peel off this protective covering and place the part in position. In the "dry" type, the dry cemented surface has no covering. The operator just moistens it with a solvent (toluol, naphtha, carbon tetrachloride or thinner) on a brush or rag. Both types are popular with workers. There is no mess, nothing to irritate hands or soil clothes.

The adhesive-backed rubber parts are clean and easy to handle, they can be placed quickly and accurately in position and they eliminate the messiness and fire-hazard of cementing at the point of assembly. They adhere well to all surfaces.

While they cost slightly more than non-adhesive-backed parts, they result in actual savings by speeding assembly, reducing worker clean-up time-out and lowering insurance rates by limiting the fire hazard. (219)

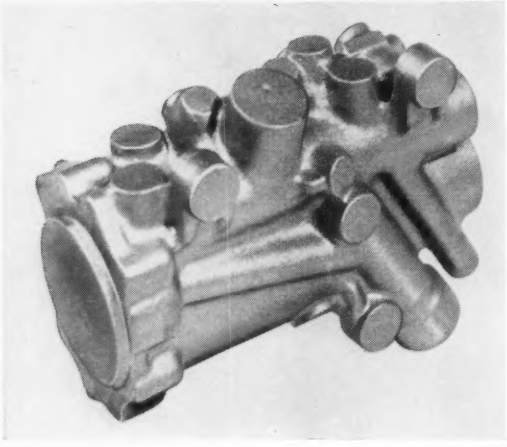


Afterburner casting: a problem and a solution

Early efforts to produce this casting (both by Cooper Alloy Corporation and other foundries) met with little success.

The part is for the main body of an afterburner fuel ignitor valve component on the Pratt & Whitney J-57 jet engine.

Part of the problem lay in the need for a tough, heat-resistant tool steel casting to withstand elevated temperatures. Cooper Alloy 15A (a stainless steel with 1.5% C, 12% to 14% Cr, 1% Cb, 1% V and 1% Mo) proved a good choice. But the nature of the alloy makes repair of defects by welding impossible.



Because of its vital function, the casting has to be defect-free under x-ray, zyglo and magnaflux inspection.

In spite of its complex shape, the part had to be cast to close tolerances. Early attempts to machine-off centre castings showed the extra machining to be an expensive operation. Chucking the irregular piece is in itself a difficult and time-consuming job.

Advanced casting know-how, combining the use of shell molds and cores, the CO_2 process and a "hot sleeve," has reduced the number of rejects by about 75%. And because shell molds and cores produce a relatively smooth surface finish with less finning, cleaning-room time has been cut about 45 min, to only 15 min per piece. Pattern and core box wear is lower; to date some 6,000 castings have been made from one set of equipment. The use of hot sleeves has increased the yield per heat, giving faster production and more pieces per melt. In addition, the head contact area on the casting has been greatly reduced, which in turn lowers foundry cut-off time. Since shell mold, shell core and hot sleeve assemblies can be made beforehand and stockpiled, rush order deliveries can be met easily. (220)

For seamless tubing: a constant pressure chucking device

Seamless mechanical tubing has some obvious advantages as a raw material for the manufacture of cylindrical parts with an axial hole. The fact that the hole is already there reduces machining; the physical properties of tubing are usually superior to bar stock; and (unlike forgings) seamless tubing can be run on automatic screw machines.

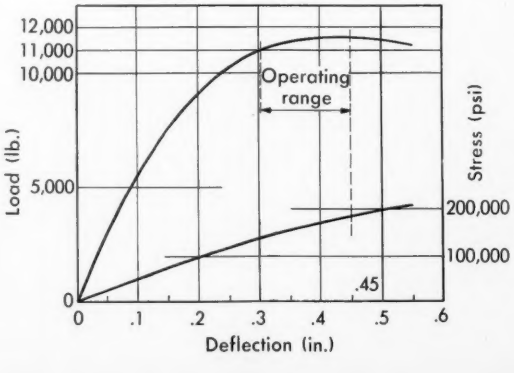
One objection to the use of hot rolled tubing is that each new tube must be chucked up by the hand mechanism, to be sure that the chucking pressure is right, because the new tube may be either larger or smaller than the tube that was previously on the machine. On small machines this extra labor does not cause serious concern, but it takes a strong man to handchuck a 6, 8 or 10 in. tube weighing as much as 1 ton.

The development of a suitable constant pressure chucking device incorporating Belleville Springs was thus undertaken by The Timken Roller Bearing Company in co-operation, first with the New Britain Gridley Machine Company, and later with National Acme and Cone Automatic.

It is known that Belleville springs can be designed so that relatively flat load-deflection curves can be obtained over a wide range of deflection.

Mathematical analyses showed that for any size machine, sets of Belleville springs giving the desired chucking pressure and working deflection could be designed.

The typical load-stress-deflection chart shows the condition desired. Note that over a deflection range of .300 to .450 in., the load change is quite small. (221)



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More section properties

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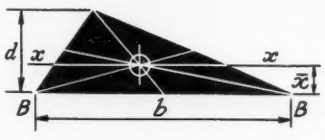


$$\text{Area A} = \tfrac{1}{2}bd$$

$$\bar{x} = d/3$$

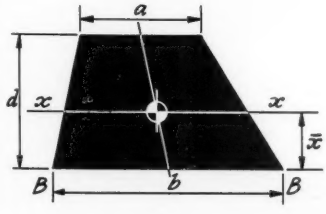
$$I_{xx} = \frac{bd^3}{36}$$

$$Z_{xx} = \frac{bd^2}{24}$$

$$\rho_{xx} = \sqrt{\frac{I_{xx}}{A}} = .2357d$$

$$I_{BB} = \frac{bd^3}{12}$$

TRAPEZIUM



$$a = nb$$

$$A = \frac{bd}{2}(n+1)$$

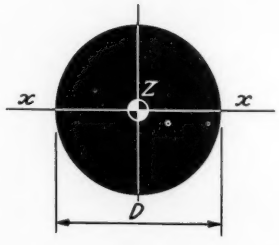
$$\bar{x} = \frac{d}{3}\frac{(2n+1)}{n+1}$$

$$I_{xx} = \frac{bd^3}{36}\frac{(n^2+4n+1)}{n+1}$$

$$I_{BB} = \frac{bd^3}{12}(3n+1)$$

$$\rho_{xx} = \sqrt{\frac{I_{xx}}{A}}$$

CIRCLE



$$A = \pi/4D^2$$

Moment of inertia about xx (or any diameter)

$$I_{xx} = \pi/64D^4 = .049D^4$$

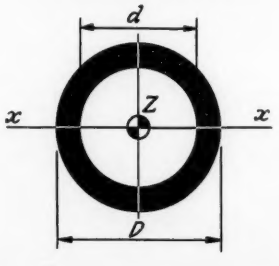
$$Z_{xx} = \pi/32D^3 = .098D^3$$

Polar moment of inertia

$$I_{zz} = \pi/32D^4$$

$$\rho_{xx} = \sqrt{\frac{I_{xx}}{A}} = \frac{D}{4}$$

HOLLOW CIRCLE



$$A = \pi/4\,(D^2 - d^2)$$

Moment of inertia about xx (or any diameter)

$$I_{xx} = \pi/64\,(D^4 - d^4)$$

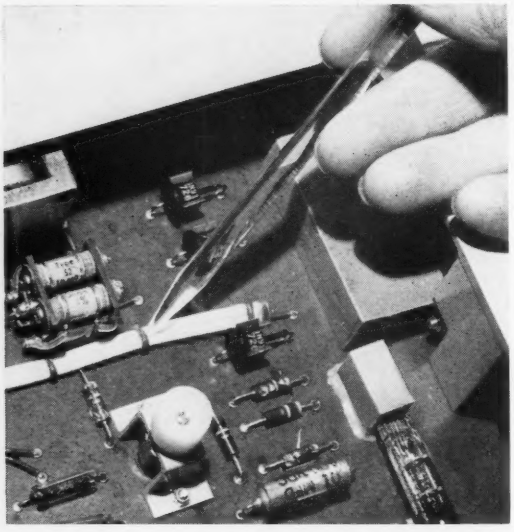
$$Z_{xx} = \frac{\pi}{32D}(D^4 - d^4)$$

$$\rho_{xx} = \sqrt{\frac{I_{xx}}{A}} = \frac{\sqrt{D^2+d^2}}{4}$$

Polar moment of inertia

$$I_{zz} = \pi/32\,(D^4 - d^4)$$

Mouse tails: rubber ones secure wire bundles to a chassis

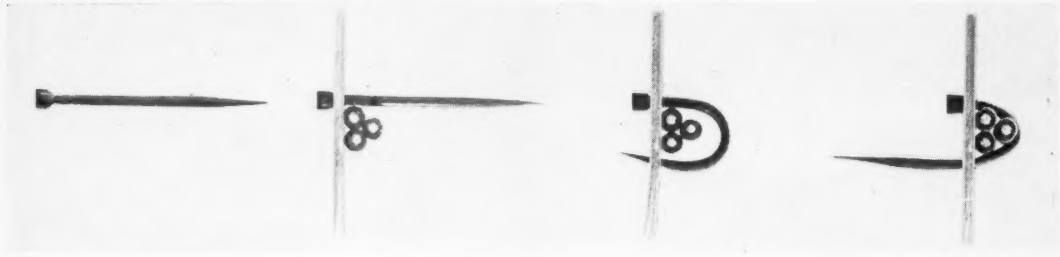


Shown here is an electronic package for Boeing Airplane Company's IM-99 Bomarc interceptor missile using a recently developed "mouse tail" for securing wire bundles to the chassis.

These mouse tails are made of a tough rubber compound. About 1½ in. long (tapered at one end and knobbed at the other) they are installed easily by passing the tapered end through a hole in the chassis, looping the shank over the wire bundle and re-inserting the tapered end through an adjacent hole. The button acts as a stop, so that the rubber can be cinched up tight. When tension is relieved, expansion of the rubber holds the tail firmly in place.

A series of laboratory shake tests has proved that these mouse tails will hold firm under all the conditions expected during the missile's flight. They do away with the need for clamps or waxed string ties. As a result, both weight and manufacturing time are saved.

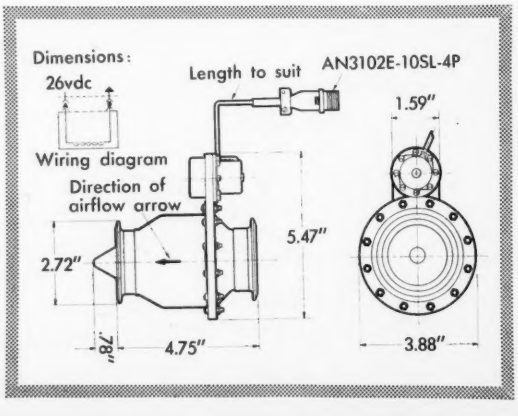
Laboratory tests are now under way to develop larger mouse tails for use in mounting resistors, condensers and other parts. It would appear that the holding power of the larger variety is positive enough (even during missile firing) to warrant their use. (222)



Poppet valve: for closure on power or pneumatic failure

Where a minimum operating pressure of 10 psig exists (and uniform timing is 5 sec maximum) a specially designed, Barber-Colman electro-pneumatic poppet valve is available. This is smaller and lighter than similar-sized butterfly valves, and is available in several sizes with various mounting provisions and flange details. A 400-cycle or standard 26-volt dc solenoid may be used. A stationary piston inside a movable cylinder reduces the complexity of the valve.

The valve is specially useful in applications requiring closure on either power or pneumatic failure. External leakage for a typical 2-in. valve is 0.02 lb/min at 150 psig and 600 F (with the valve closed). Internal leakage is 0.07 lb/min at 150 psig at 600 F. Ambient temperature range is —65 F to 300 F (continuous duty) and —65 F to 350 F (intermittent duty). Other sizes and operating pressures are available. (223)



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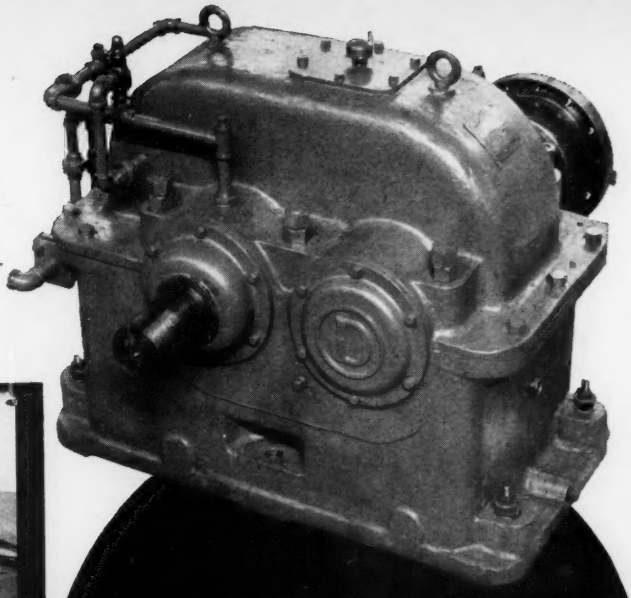

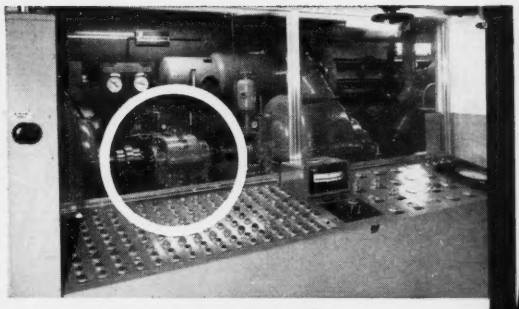

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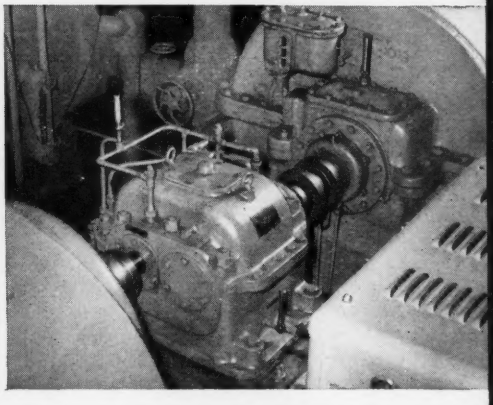

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Features High Production Semi-Automatic Welding

METAL FABRICATORS have looked for a mild steel welding system as simple to use as stick electrodes, but without the disadvantages of low duty cycle, stub waste, etc. The new L.A. Dynaweld continuous arc welding system completely fills that need. Designed and developed by Canadian Liquid Air Research and Engineering teams, the new process has just been released after more than a year of extensive field tests under practical conditions in several major industries in Canada.

Among its many advantages is the substantial increase in productivity when the system is properly used on suitable applications. This results from the high duty cycle and the higher-than-usual current rates used, with consequent greater deposition of weld metal. Simple to use, the L.A. Dynaweld process is *completely independent of water cooling or gas shielding.*

Basically, the heart of the Dynaweld system is a precision-twisted coated filler wire which is essentially a "*continuous*" *coated mild steel stick electrode.* The wire is drawn off its power-driven supply reel at predetermined speeds through associated equipment and fed through a specially designed pistol-type electrode holder. Welding current is supplied from any standard AC or DC welder, the latter being preferred.

No complex mechanical or electronic apparatus is involved in the Dynaweld system, nor is any auxiliary apparatus (other than the source of welding current) required in its operation. Extremely portable and flexible in use, the ruggedly built machine has few moving parts and maintenance is negligible.

The L.A. Dynaweld system is highly recommended for production mild steel welding operations where presently large quantities of conventional or iron powder stick electrodes are being used. Metallurgically, weld deposits from Dynaweld wire are comparable in every way to those from standard mild steel stick electrodes in the AWS E 6012, E 6024, and E 6020 classifications.

For further information about the new L.A. Dynaweld system, contact your local Branch office of Canadian Liquid Air Company Limited, where arrangements can be made for a practical study of your plant's welding applications to determine the suitability of this process for your operations.

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Book Department

Notes on analog-digital conversion techniques. The outgrowth of a special summer program on analog-digital conversion techniques held at the Massachusetts Institute of Technology late in 1957, this book offers a detailed exposition of both theory and design. The authors have stressed fundamental concepts and have expressed these concepts in quantitative terms where possible. Inherent engineering limitations are taken into consideration and relative merits of various approaches are weighed.

The presentation is suitable for readers who have been away from the formal academic work for some time and who have little previous knowledge of the field. The authors have selected the subject matter considered to be of greatest interest to the practising engineer.

The book is published jointly by the Technology Press at M.I.T. and John Wiley & Sons, Inc. The price of the book is $10.

Logical design of digital computers. It is the intention of author Montgomery Phister Jr. that this book should form the basis of a one or two semester course in computer logic, introducing the student to the art and science of designing these digital systems. The book describes techniques, not computers, and should serve to present the practical application of these techniques to interested engineers, mathematicians and physicists.

No previous experience with computers is assumed, and the text is liberally sprinkled with work samples and with exercises so that a serious student should have no trouble in acquiring some dexterity in digital design as well as a knowledge of the problems and possibilities.

The book is available from John Wiley & Sons, Inc. The price is $10.50.

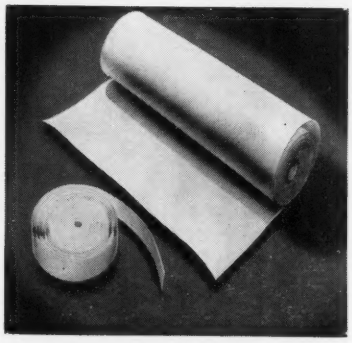
Ceramic fabrication processes. Outgrowth of the 1956 special summer program in ceramics at M.I.T. This book gives both the technical basis and present practice of ceramic fabrication, showing the relationship between principles and the art. Twenty-two outstanding scientists and engineers closely connected with many phases of ceramic processing here evaluate the significance of current developments and indicate probable avenues for future progress.

The 235-page book has been published jointly by the Technology Press at M.I.T. and John Wiley & Sons, Inc. The price of the book is $9.50.

New Products

Teflon tape

The United States Gasket Company is now producing Teflon tape in widths up to 24 in. and thicknesses ranging from .005 in to .096 in. In addition to its many industrial uses, the tape is cur-



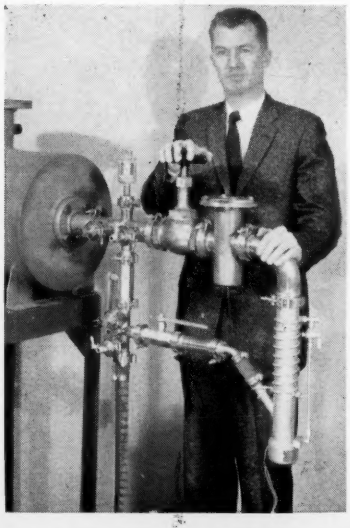
rently being supplied to the aircraft industry for lining skis on planes that are being used in frigid regions. This versatile Teflon tape is also available as cementable tape. (224)

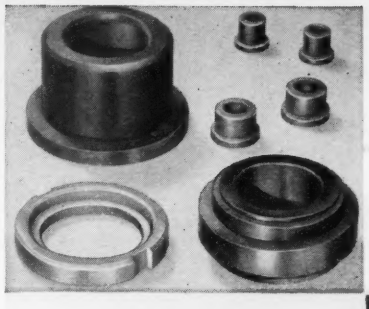
High vacuum components

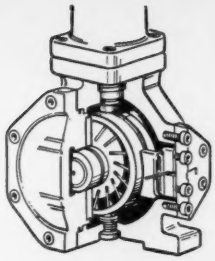
An integrated line of high vacuum components equipped with mating quick-connect flanges has just been introduced by NRC Equipment Corp.

The building block pumping system makes it economically feasible for laboratories to extend their investigations into substantially lower pressure ranges. Many laboratories are equipped for experimentation at pressures down to 10^{-2} mm Hg, but have shied away from in-

Continued overleaf







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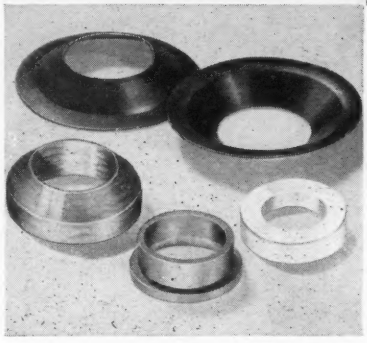

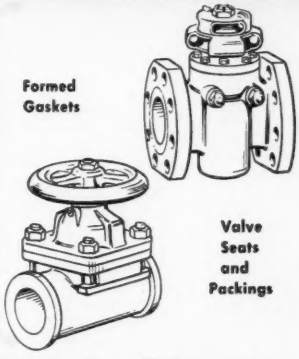

Formed Gaskets

Valve Seats and Packings

It has been definitely established that the value of Teflon can be considerably enhanced by the use of fillers in certain applications. Laboratory and field experience has demonstrated that the use of fillers permit Teflon to be more readily tailored to a wide variety of chemical, electrical and mechanical applications. Also, some mechanical properties can be improved. These include:

1) resistance to deformation under load
2) resistance to wear
3) thermal conductivity
4) compressive strength
5) hardness

By thus improving its properties, Teflon now offers even greater industrial potential. This is the reason filled Teflon has become an important item in the "John Crane" Chemlon® line of better Teflon products.

Chemlon is available with such fillers as glass fiber, carbon, graphite, copper and bronze, talc, calcium fluoride and other inorganic materials.

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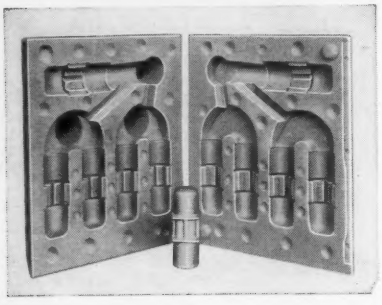


FAST . . . ACCURATE . . . INEXPENSIVE

Tallman shell moulding techniques make better castings in non-ferrous metals—faster and at lower cost.

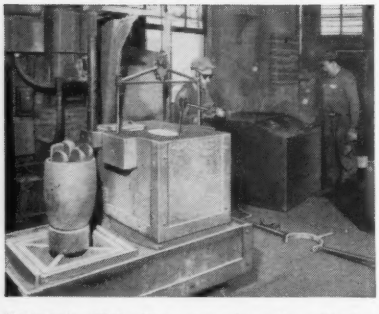
Accurate moulds of fine sand and thermosetting resin produce smooth, well finished castings to extremely close tolerances.

These quality castings

- minimize and often eliminate expensive machining operations.
- reduce weight of castings in most cases.
- effect savings in time and money.

Call or write today . . . find out how Tallman techniques can better fill your casting requirements.

CONTROLLED MELTING



Tallman's High Frequency Induction Melting Furnace attains the ultimate in melting efficiency for both bronze and aluminum.

Temperatures over a wide range can be controlled to the specified degree for any required duration — a necessity when manufacturing castings of special alloys to perform under difficult conditions.

Let our experienced, highly skilled personnel assist you on your casting requirements.

Write today for further information on how our modern techniques and facilities produce better castings at economical prices.

Tallman Bronze
COMPANY LIMITED · HAMILTON ONTARIO

New products
Continued

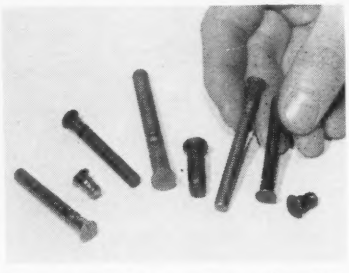
vestigations at lower pressures because of their reluctance to invest capital funds in equipment which is costly and not readily adaptable from one project to another.

The new system permits operation down to 10^{-7} mm Hg, and should find application in pilot plants and small production operations as well as in laboratories. (225)

Aircraft fasteners

Aircraft type fasteners fabricated from high alloy die steels and a variety of stainless steels are now available from Huck Manufacturing Co.

The new fastener specifications have been developed primarily to meet recent demands for miniaturized fastener designs for use in new missile programs.

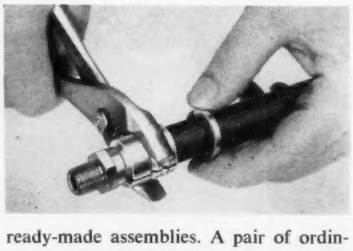


The new materials permit use of smaller, lighter components with no sacrifice in strength. They are recommended for use in elevated temperature applications where unusually high strength is required. (226)

Air brake hose

The development of a new truck air brake hose and easy-to-assemble segmented fittings has been announced by Aeroquip (Canada) Ltd. Typical applications for the new hose include tractor-to-trailer service lines on buses, trucks, off-the-highway vehicles and military equipment.

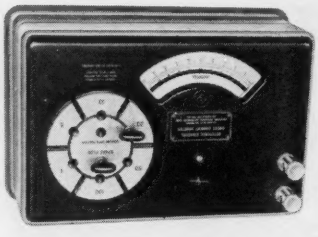
With the new hoses, it is no longer necessary to maintain large stocks of



ready-made assemblies. A pair of ordinary hand pliers is the only assembly tool needed, and the ease of assembly permits making up hose assemblies anywhere. Male pipe and swivel nut hose fittings are available, with or without spring guard. (227)

Direct reading dc ammeter

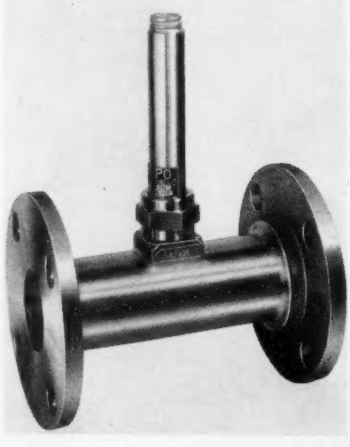
A new heavy current precision dc ammeter that is claimed to fill the need for accurate measurement of a wide range of currents at a moderate cost has been developed by Sensitive Re-



search. Self-contained and portable, this instrument eliminates external shunts and leads. Ranges are selected by means of positive-fitting tapered plugs and holes. The movement features diamond pivots and shock-mounted jewels for ruggedness and repeatability. (228)

Flow Transducer

The Ramapo Instrument Company, Inc. announces the development of a new version of its flow transducer. This new model features housings with welded steel flanges in all nominal pipe sizes and extends the application of their Mark V model to cover virtually any



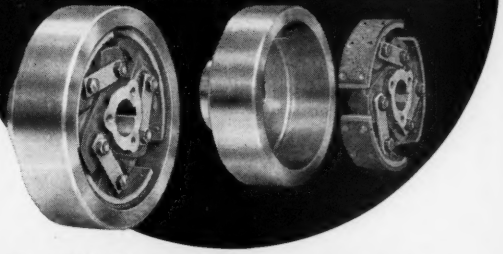
industrial flow requirement, subject only to a 10-1 range limitation on any single transducer. Since the instrument is phase sensitive, it automatically detects direction of flow and will indicate accordingly.

The flow transducer is constructed of stainless steel, has no bearings or moving parts and is, therefore, particularly suitable for use with acids, caustics and other difficult liquids. (229)

Continued on page 86

Flexible ACTION IN THE *New* HILLIARD TWIFLEX

AUTOMATIC CENTRIFUGAL CLUTCH COUPLING



11 NEW IMPORTANT FEATURES . .

1. Flexible in all directions.
2. Absorbs Shock.
3. Limits torsional vibration.
4. Has adjustable idle speed
5. Can be furnished in automatic free-wheeling type.
6. Smooth starting.
7. No slip under normal load at full speed.
8. Protects driver and driven mechanisms against overload shock.
9. Can be furnished in automatic backstop type.
10. Prevents torsional resonance.
11. Easily assembled even in blind installations.

If you have problems of misalignment - smooth starting - vibration - overload - or assembly in the manufacture or operation of:

- Compressors
- Blowers
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- Excavators
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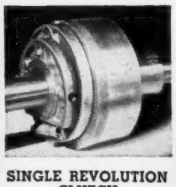
- Hammer Mills
- Textile Machinery
- Wire Machines
- Fans
- Gasoline Engines
- Back Stop Brakes
- Mixers
- Conveyors
- Pumps
- Electric Motors
- Generators
- High Speed Pulverizers
- Tube Mills

- Let Our Engineers Consider Your Problem. Twiflex May Be The Answer.

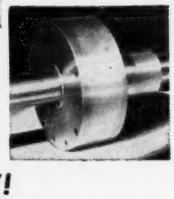


SINGLE REVOLUTION CLUTCH

For automatic, accurate control, electrically or mechanically, of intermittent motion, indexing, cycling, cut-off.
Write for Bulletin 239.

OVER-RUNNING CLUTCH

For automatic engagement and release on two speed drives, dual drives and for ratchet feed or backstop action.
Write for Bulletin 231.



SLIP CLUTCH

For overload protection — constant torque — constant tension on reeling or winding stands.
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For Details of TWIFLEX Coupling in Catalog CE-3

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THE HILLIARD CORPORATION
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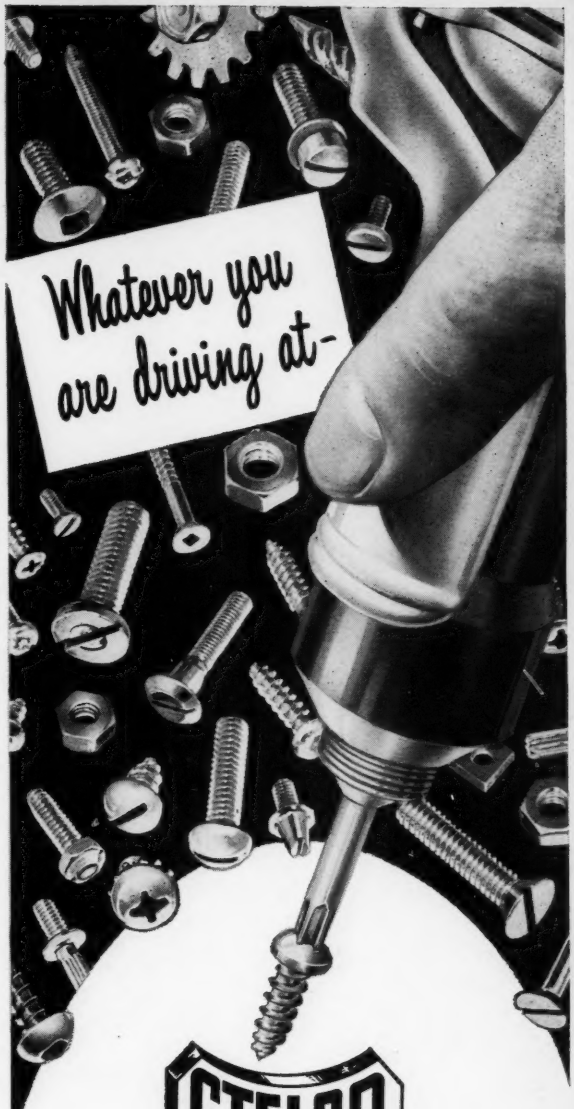
MANUFACTURING CLUTCHES FOR 50 YEARS



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Sizes and types for heavy-duty automotive, construction and road building machines, farm implements, tractors and industrial machinery

SAVE YOUR ENGINEERING TIME

Here at Blood Brothers you can select from a wide, wide range of universal joints and complete drive assemblies. Torque capacities range from 350 to 500,000 inch lbs. — lengths from very close-coupled industrial joints to assemblies 120" overall.

You can be confident they are produced in a modern, centrally located plant, tooled for precision manufacturing. And you can rely on their high reputation for dependability.

When you specify Blood Brothers, you can save valuable engineering time by stating your problem to our service-minded engineers. They're cooperative, friendly and long-experienced. Just write or call.

WRITE FOR BULLETIN 557 . . .
and for your convenience in specifying, request our free Blank Form "Specification Sheets".

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ROCKWELL-STANDARD CORPORATION
(Formerly Rockwell Spring and Axle Company)
Blood Brothers Universal Joints
ALLEGAN, MICHIGAN

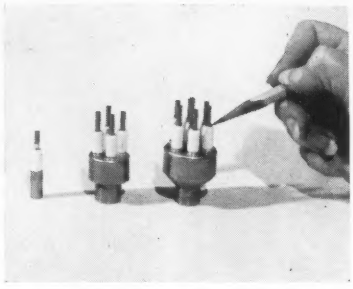
New products

continued

Cable end seals

A line of vacuum-tight ceramic-to-cable end seals capable of standing temperatures of 1,400 deg. F and pressures of 2,000 psi is being marketed by Advanced Vacuum Products Co.

Increased temperature and pressure ratings are due to a pre-brazing coating



of molymanganese which becomes an integrally fused part of the metal. The coating permits a stronger ceramic-to-metal bond with a pure silver braze which results in substantially higher temperature operating limits. (230)

Sealing compounds

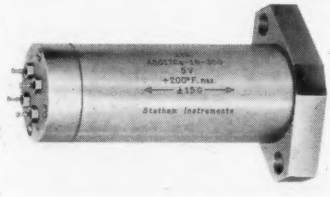
A revised 4-page ready-reference chart containing up-to-date information about all Johns-Manville sealing compounds is now available.

This new chart, which gives at a glance all the principal properties of J-M sealing compounds, will be an extremely useful guide to those requiring sealing compounds for industrial purpose. (231)

Accelerometers

A new concept in the design of unbonded strain gage accelerometers is claimed by Statham Instruments, Inc.

The utilization of gas damping, which is incorporated in their new accelerometer is the remarkable new design feature. This method of damping permits the operation of the device over a wide temperature range without the addition of a heater jacket.

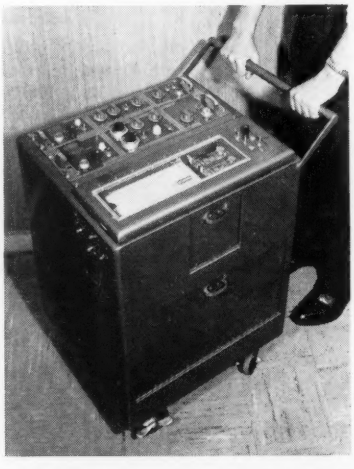


The performance of the new unit excells conventional accelerometers in frequency response by a factor of two. For example, at room temperature this instrument has a useful frequency band which is twice as wide as a standard accelerometer, while at temperature extremes, such as —65 deg F to —200 deg F, the useful frequency band of the model is approximately the same as that of a conventional accelerometer at room temperature. (232)

Mobile oscillograph recorder

Designers and engineers making use of recording instrumentation, will be interested in the Edin mobile 2-channel recording instrument which has just been developed. The recorder simultaneously depicts and records such phenomena as voltage, current, pressure, vibration, temperature, displacement, strains, acceleration or force.

Built to withstand rough treatment, the sensitive unit will reliably record, for example: strains as low as 10 microinches per in. and currents as low as 1 microvolt. Weighing 100 lb and standing only 31 in. high, the compact instrument contains a 2-channel direct-writing recorder with a choice of any two standard amplifiers.



Rubber-tired, non-static and self-locking casters are employed which permit the unit to be quickly wheeled between recording locations. (233)

Photo-recording paper

A new photo-recording paper which is capable of providing an instantaneous visible record of instrumentation tests data is now available from Canadian Kodak Co. Ltd.

The photo-recording material may be used in conjunction with several new, special-type moving-mirror galvanometer oscillographs. The company points out that the new paper should find wide application for immediate read-out of test results in the missiles and aircraft field, oil exploration, automatic, medical, nuclear, and many other control, production, and computing operations.

The one paper will supply data on in-flight missiles, for example, as quickly

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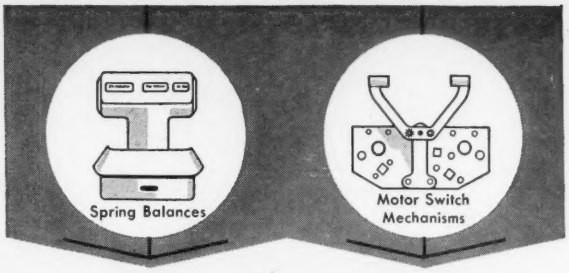
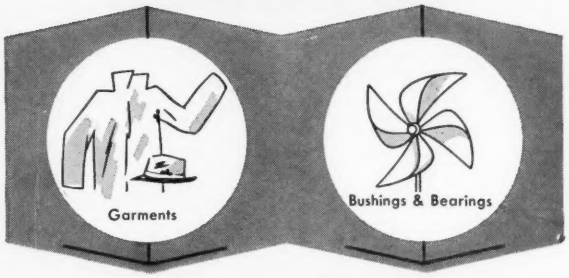
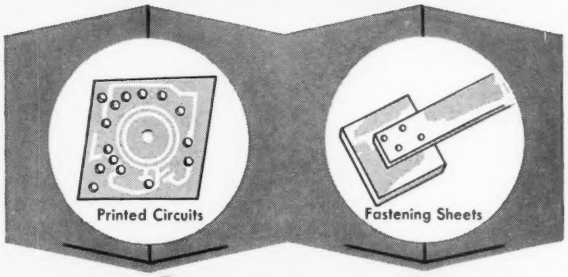


Production



moves faster



and costs less

when you use

UNITED EYELETS

United's STANDARDIZED EYELETS — comprising more than 60 different eyelet sizes — answer a need of the industrial user and designer for an orderly, simplified method of determining which eyelets will meet their specifications.

Efficient and economical to use, United's STANDARDIZED EYELETS, are readily adaptable as fasteners, reinforcements, decorations, pivots, bushings or any combination of these uses.

UNITED has eyelets especially suited for fabric work, paper and card work and for articles such as window shades, belts, corsets, games and an infinite variety of uses.

Contact a USMC field technician to help you solve your problems right on the job. Stocks carried for quick delivery.

CUSTOM EYELETS made to your specifications.

57-1

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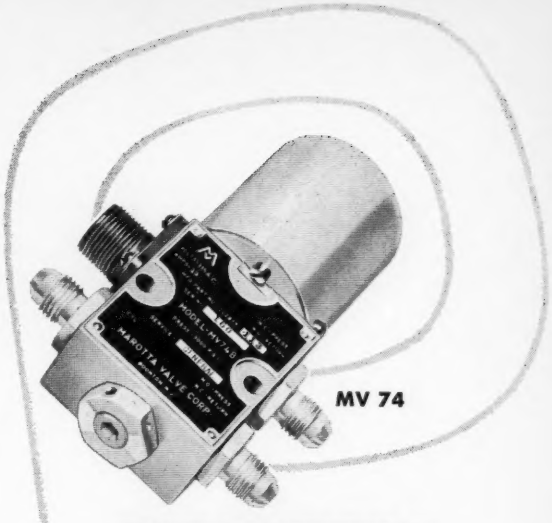

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- 24 V.D.C. Power or
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- Fast Actuation
- Pressure ranges up to 6000 psi
- Most fluid services
- Manual overrides

for applications that require...

2 way normally closed
2 way normally open
3 way normally closed
3 way normally open
or shuttle operation

That's the versatile Marotta 3 way, 2 position, ¼ inch tube MV 74

Another addition to the over 300 Marotta valve models now in general use throughout industry.

PRV-11A Special 6" 160 psi LOX Pressure relief

RV-23 ¼" Pneumatic Regulator-Hand Type 50 to 4500 psi

MV-41A ⅜" N.C. 1000 psi Fuel Solenoid

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graduate engineers available for consultation

Marotta VALVE CORPORATION

pioneer producers of high pressure valves

P. O. BOX 330-K BOONTON, N. J.

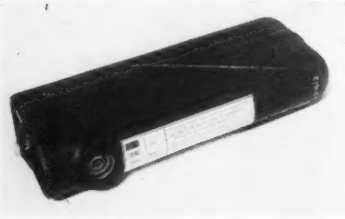
New products
continued

as ten seconds after phenomena under observation take place. It is expected that the product will help avoid costly mistakes during in-flight and on-the-ground missile and aircraft tests by enabling technicians to take immediate corrective measures when malfunctioning occurs.

Rigorous field tests indicate that the new paper will help technicians make immediate adjustments for incorrect or insufficient test conditions before test equipment and personnel disperse. (234)

Dehydrator

A dehydrator, which uses a desiccant (adsorption agent) to remove water-vapor from the air by the adsorption



process of dehumidification, has been introduced by the Farr Company.

The dehydrator employs a modern non-dusting bead type desiccant to obtain maximum air drying capacity, long life and economical operation. It has been designed for use in such sensitive systems as fire control, radar wave guides and gyros.

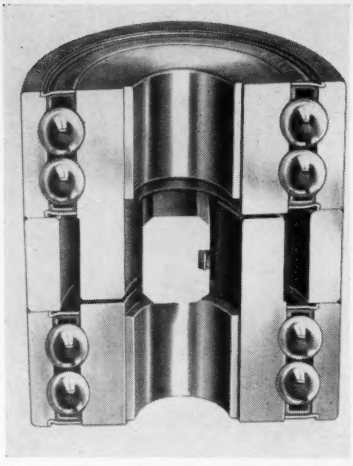
Air is passed through a 40 micron filter and along an extended flow path to give maximum exposure before leaving the dehydrator through a 10 micron filter. An indicator tube with indicator silica-gel in each unit shows when the relative humidity of the air leaving the dehydrator exceeds 4%, indicating the unit needs reactivation. (235)

One-way torque bearings

Standard bearing assemblies are now available for positive control of angular shaft position. Produced by Ann Arbor Bearing & Mfg. Co. they prevent independent movement of a driven shaft except when rotation is produced by a drive shaft.

Both shafts insert in the bearing assembly. Two conventional double row ball bearings, with extended inner rings, are used on either end. Between the two is a lock ring, containing a spring-loaded lock bar.

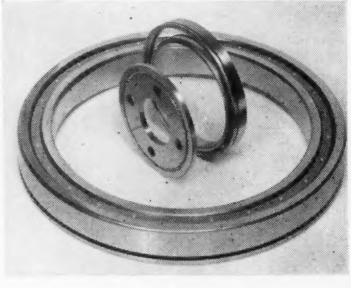
Drive shaft rotation compresses the spring and releases the lock bar. This permits rotation to be transmitted to the driven shaft. However, any independent driven shaft movement will cause the



lock bar to wedge tight against the fixed outer lock ring. Driven member lash is less than 2 deg.; drive shaft lash is less than 4.5 deg. (236)

Thin-section bearings

Thin-section radial ball bearings, especially designed or built to specifications, are a new addition to the line of Ann Arbor Bearing and Manufacturing Co. This company has devised thin-section techniques for bearing fabrication to eliminate warpage. Warpage has been the major difficulty in the development and production of bearings of this type in the past.



Developed specifically for designs where space and/or weight must be decreased, thin-section bearings will find broad application in many fields. Initial installations in which thin-section bearings have been used are: aircraft equipment, portable air tools, magnetic clutches and portable chain saws. (237)

Sound detector

A binaural engineer's sound detector makes it possible to locate the smallest internal defects in moving machinery without shutting down or otherwise taking equipment out of service.

This lightweight detector amplifies normally inaudible defect-caused noises and helps the user to accurately locate broken, loose, worn or bent parts in engines, gear boxes, compressors, pumps and similar equipment, regardless of

Continued on page 90

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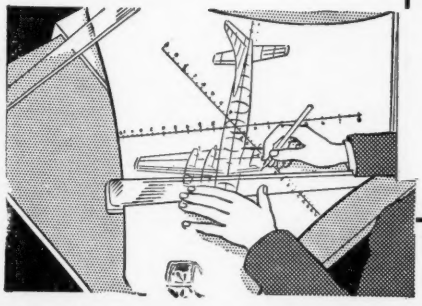

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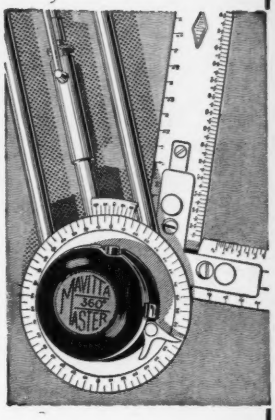

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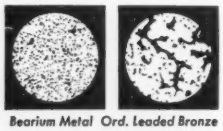

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New Products

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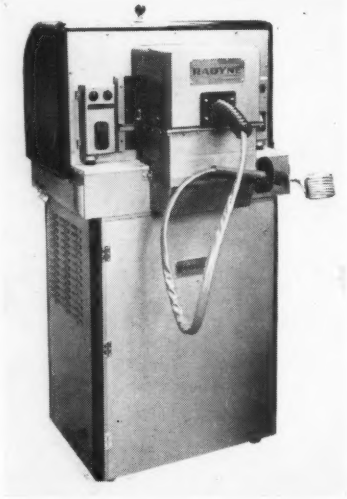
size. It is also extremely useful in determining the efficiency of steam traps and for locating leaks in air, gas or liquid lines. The detector utilizes dual detectors to transmit sounds to one or both ears as desired. Each detector contains both a pick-up diaphragm and an amplifying diaphragm to provide maximum sound vibrations. (238)

Induction heater

This mobile equipment provides over 105 amperes into 5 micro-henries or 60 amperes into 22 micro-henries — ample for any rotary electronic tube pumping machine.

The equipment is extremely simple in design, enabling the unskilled operator to set it up for production use. Fitted to the equipment is the standard

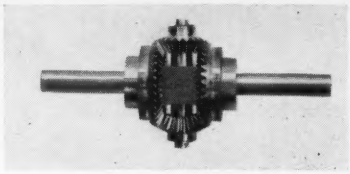


variable coupling output transformer giving smooth adjustment of power from zero to full output. The output transformer is of the high impedance type, modified to include a special tuning condenser in order that an exceptionally high kva can be obtained, and is ideally suited for use with multi-station gettering where a large number of coils are fed from one equipment. (239)

Bearingless differential

A bearingless differential having a backlash of approximately 30 minutes of arc is now available from Dynamic Gear Company Inc. This is in addition to Dynamic's stock precision ball bearing differential.

Constructed of stainless steel spider and bronze bevel gears, both 48 and 72 diametrical pitch, the Dynaco bearingless variety tumbles within 1 in. plus 1/32 in. and any standard Dynaco stock precision hubless gear may be assembled to it. The 48 pitch version is available



with a .1874 in. shaft and the 72 pitch model with a .1249 in. shaft. A shaft up to 4 in. over-all projection to user's specification is included with longer shaft units being available on request. (240)

Liquid level sensor

A unique liquid level sensor which utilizes a radioactive material in the sensing element has been introduced by Robertshaw-Fulton Controls Co.

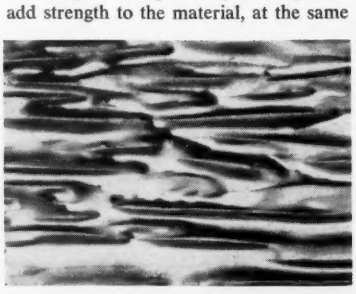
Designed to provide an actuating signal to control or indicate a predetermined level, the unit employs beta radiation to furnish the benefits of nuclear research for more reliable and accurate industrial instrumentation.

Said to operate with extreme accuracy and reliability in water, acids, alkalies, oils and viscous liquids, Betatrol (as the device is called) consists of a small sensing probe mountable in any attitude, that may be connected by up to 200 ft of cable to an amplifier.

A relay in the amplifier may be used to operate remote warning devices or motor starters, valves, timing devices, and other mechanisms which may be used to maintain liquid level. (241)

Textured metals

Seven new textures on metal have been developed by Ardmore Products Inc. In addition to an attractive surface that resists mars, dents, scuffs and even finger-prints, this material has many inherent functional properties. Some of the designs were primarily developed to add strength to the material, at the same



time decreasing the basic metal thickness and weight. Others have definite functional values such as non-skid, greater heat dissipation, controlling condensation and flow of liquids eliminating glare by providing even light diffusion, to mention a few. (242)

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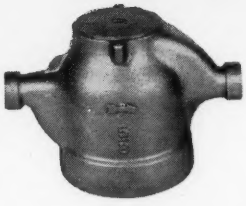

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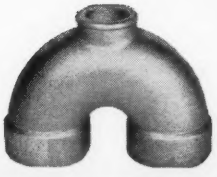

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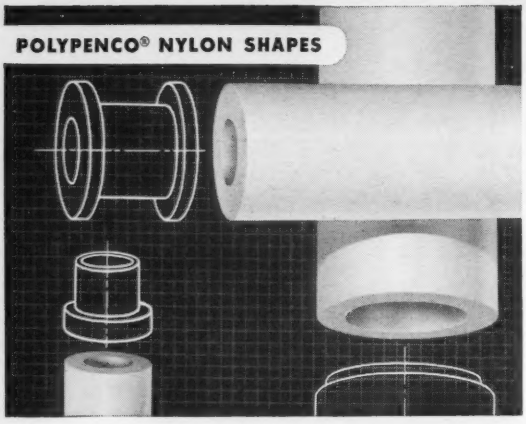

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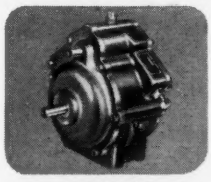

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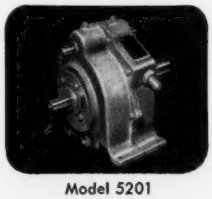

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Editorial

More work and a little less play

A conference on Reliable Electrical Connections (to be held in Dallas, Texas, next December) will be conducted on somewhat unusual lines. All the papers will be printed and ready for distribution six weeks in advance of the conference; no time will be wasted in listening to the reading of papers. Instead, each author will give a brief summary of the paper (to introduce the topic); the conference will then be thrown open for discussion. There will be no exhibits, no formal lunches or dinners, and no entertainment because (so the advance publicity states) of the importance of the subject. This is indeed a departure!

It may be remembered that in the February editorial of this magazine, mention was made of the reporter-system recommended by the ASME. This conference seems to be following on the same general lines.

Strain gauge techniques

Two special summer programs on strain gauge techniques will be given in July at the Massachusetts Institute of Technology, under the immediate supervision of Dr. William M. Murray, Professor of Mechanical Engineering at M.I.T. They will provide a co-ordinated presentation of the characteristics and uses of wire and foil resistance strain gauges.

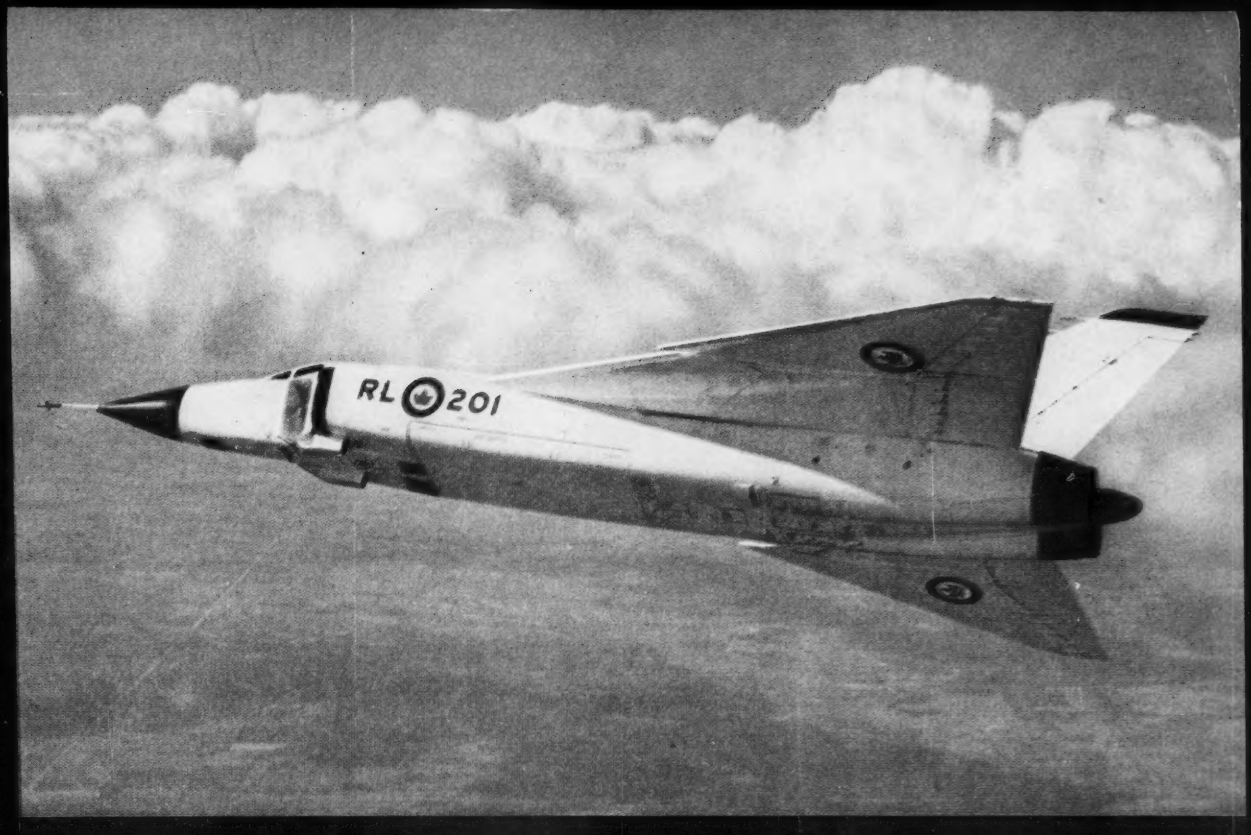
Emphasis will be on the practical application of the various techniques used in solving industrial problems and on recent advances in high temperature techniques.

Although the programs will be presented largely from the point of view of the mechanical engineer, the topics have been selected to provide maximum benefit to those already skilled in stress-analysis, but with little experience in electrical instrumentation, or for experts in electronics who are unfamiliar with the various aspects of stress analysis.

80 top ideas

There has been good response to our mailing for design highlights for the July issue of the magazine. We are at the moment busy picking out the entries that we feel are the best, a difficult job if ever there was one!

William Morse.



▲ The Avro Arrow is shown in flight during test manoeuvres over Ontario.

The Arrow weapon system is a bomber-destroyer having supersonic mission capabilities. ▼

The Avro Arrow is as big as a World War II bomber yet took off on its first flight in only 3,000 feet of the 11,000 foot runway at Malton. ▼

AN ARROW IN THE SKY

Since its first flight on March 25th, the Avro Arrow has been meeting the vigorous demands of its extensive flight test program. Proceeding according to plan, the Arrow flew faster than sound on its third flight, and more than 1,000 miles per hour on its seventh flight.

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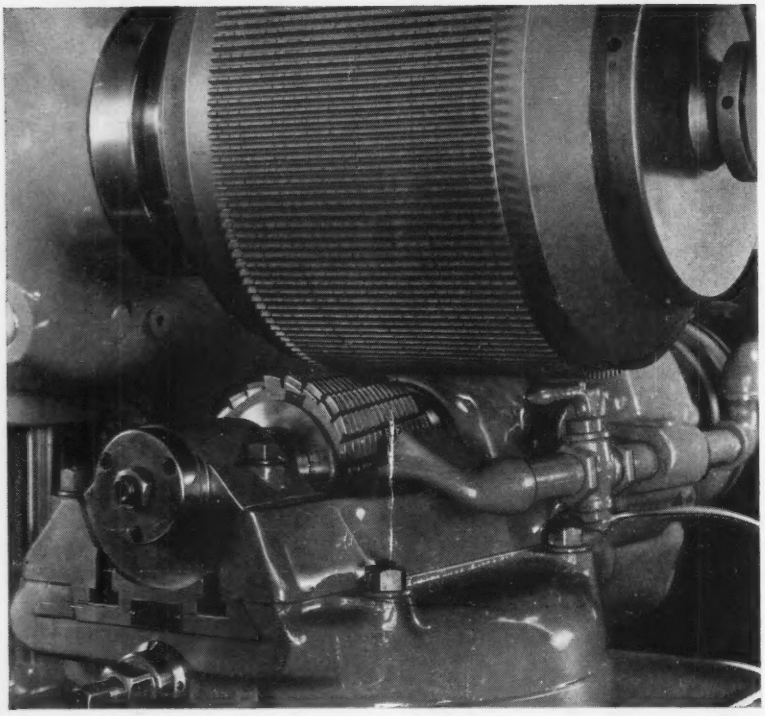
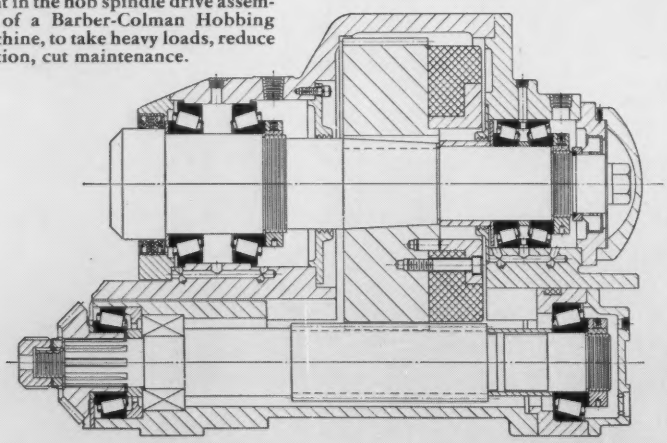
Hobs at speeds of 300 SFM —TIMKEN bearings shrug off heavy loads



TYPICAL Timken bearing arrangement in the hob spindle drive assembly of a Barber-Colman Hobbing Machine, to take heavy loads, reduce friction, cut maintenance.



TO take the heavy loads and minimize friction when hobbing steel gears at high speeds—up to 300 SFM—Barber-Colman uses Timken tapered roller bearings at vital points in its No. 14-15 Hydraulic Hobbing Machine. The high speed hob slide has a hob spindle mounted in Timken bearings. They're also used in the hob drive and for the top bearing on the index worm shaft. Result—gear production is faster, more accurate. Tool life is increased.

SHRUG OFF HEAVY LOADS. Timken bearing rollers and races are case-carburized to have a hard, wear-resistant surface over a tough, shock-resistant core. They take heavy loads with no trouble at all.

KEEP SPINDLE RIGID. Timken bearings hold the spindle in positive alignment. Their tapered design lets them take *both* radial and thrust loads in any combination. And they have extra load-carrying capacity because of full line contact between rollers and races.

PRACTICALLY ELIMINATE FRICTION. Geometrically designed to roll true, Timken bearings are precision-made to live up to their design. They run longer, smoother, cooler.

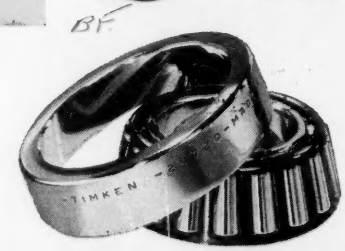
And for extra quality control, we even make our own electric furnace fine alloy steel. To get your No. 1 bearing value, always get bearings carrying the trade-mark "TIMKEN". The Timken Roller Bearing Company, Canton 6, O. **CANADIAN PLANT:** St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

BF

TIMKEN *Made in* CANADA

TRADE-MARK REG. IN CANADA AND U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

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